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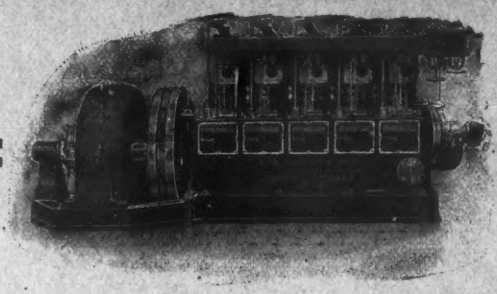

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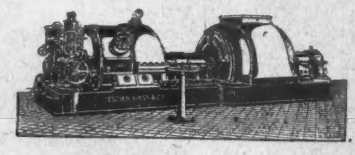

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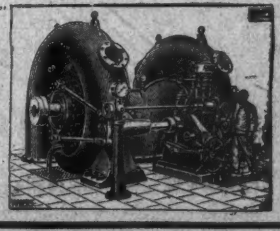

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TRAVELLING SCHOLARSHIPS.

THE building up of substantial and lasting trade connections is not, in ordinary times, a matter of weeks or months. In war-time, when supplies from some directions are cut off and markets are in need, orders can be obtained practically for the asking if we are in a position to execute them; and it may be that some of these orders given in a hurry, will by reason of satisfactory service, and perhaps by reason of allied sentiment, be followed by others from the same sources after the return of Peace. In normal times, however, and speaking generally, foreign trade connections, save for quite specialised lines of trade, are a plant of slow growth. We survey markets, prepare literature, advertise the goods we make, and, if we are wise, nurse periodically the ground we seek to cultivate; but these are only part of the effort, an important part undoubtedly, but we have to go deeper, for after we have done all these and other things along ordinary commercial lines, we may find that we have not built upon the best or most reliable foundation. The foundation that we must put in very substantially, and which does not lie in one country alone, but in both that in which we manufacture and in that in which we desire to sell, must be made up of as complete a knowledge as we can obtain of the character and the consequent requirements of the people of the market, and of closely cemented relationships and friendships or understandings imparting a complete confidence in the seller on the part of the buyer. This foundation is education. Not education of the ordinary school, college, or university type, but education of specialised types, one kind for the buyer and another for the seller. In the main, it is to be obtained by mutual interchanges of visits; taking a particular case for the purpose of illustration, the entertaining of Russian engineers and business men in England, and the deputation of British engineers and manufacturers to the markets of Russia. Much success has been known to follow organised visits of such kinds, and private parties on their own initiative and at their own expense have also found their efforts to be well rewarded. Not once, nor twice, but many times have we referred to the way in which British and German traders have educated the rising generation of engineers in non-manufacturing, and therefore purchasing, countries, and created an atmosphere and conditions congenial to the growth of trade. This lesson is not likely to be overlooked as we lay our plans for the future. The opening of our works to young foreigners whom we expect to be ultimate buyers is only one half of the matter. What we also need is the opening up of facilities in their countries for our own potential business men to learn most thoroughly, as the result of extended sojourn, observation, and education, and of intimate converse and relationship, the language and character of the people, their country, and their requirements. Those of our readers who took the trouble to read the Government Committee's report on a British Trade Bank will have noticed that one of the most important matters dealt with therein related to the need for encouraging suitable young men to leave these shores and take up residence and business interests in markets where we desire to strengthen the British commercial hold. When we nationally hold that after the war we must aim first at peopling the Mother Country and the Empire,

we shall not fail to see the necessity for assisting a number of suitable men to go to other countries in the interests of British commerce and industry, and therefore in the interests of the Empire as a whole. It may be that our young men will find it good policy, as German agents have often done, to arrange even their affections in subordination to trade interests, marrying one of the foreigner's daughters, but that we are quite prepared to leave to them—the details we need not enter into. What we must do is to make the opportunities for the young men to go to these potential markets, making it worth their while to do so, because they are the representatives of a Greater British industry. The British electrical and engineering manufacturer knows many ways in which this can be done, but it is our purpose on this occasion to describe briefly the steps that are being taken by another great department of British industry as the result of organisation of its different firms, as the scheme is considered by some to afford an example which might be profitably studied, and perhaps followed, by British electrical and engineering organisations. The Bradford Dyers' Association has offered to give 10 travelling scholarships to cover the cost of a year's residence in Russia—the gift is valued at £2,000 per annum. The proposal is made in recognition of a great and urgent local and national need, and the only stipulations attached are that candidates for the scholarships must be either connected with, or intend to be connected with, the piece goods trade of Bradford or Manchester, and that they shall have acquired an elementary knowledge of the Russian language. This language difficulty has long been one of our obstacles to Russian trade. Geographically, Germany was in such close proximity to Russia that commercial people intermingled, and a Russian need had only to be known and measures were taken to meet it. The people and their language were known, and a trip into Russia was nothing more than a run into the provincial districts here for an Englishman. Whether those relations are resumed again or not, the goodwill of the Russian people toward their Allies in this terrible war will alter matters in our favour if we can meet the needs of the situation, and we are more likely to meet those needs if we learn the language in order to understand them and fraternise with them either here or on their own soil. The Bradford Dyers' Association was fortunate, in this respect, in securing the co-operation of the Bradford Education Authority so as to give a stimulus to the study of Russian. It is stated that arrangements are now in process for the selection of suitable candidates to proceed to Russia, for the provision of their comfort and accommodation while there, and for their training and supervision. The services of the Russian Embassy and of our own Consuls in Russia have been sympathetically placed at their disposal. Students will go to university cities, such as Petrograd, Moscow, Kharkoff, Kieff, and possibly Odessa; they will attend courses of lectures, with a strong commercial bias, at universities and commercial institutions, and in a hundred ways they will be enabled to acquire an intimate acquaintance with Russia and with the habits and customs of the people, also to investigate Russian industries, securing introductions to business centres, and so forth. Of course, every student has to familiarise himself with the elements of the Russian language before he goes out, and the Educational Authority will assist to that end so that six months' study shall make him sufficiently "fit." Now only the blindest man can fail to see the most excellent possibilities contained in such a scheme; it is conceivable that in the course of time, almost incalculable benefit to British textile industries would result. And if this applies in the case of textiles, why not in electrical manufactures? It seems to us that electrically we are up against very much the same difficulties—the language and the need for knowledge of the peculiarities of the people and their country. As we hope to have ample electrical manufacturing capacity after the war we need to be far-seeing in our measures, and perhaps another £2,000 a year from the electrical industries, organised, say, from London, or Manchester, or some other big engineering centre, along very similar lines to those adopted in the case of the Bradford Dyers, might prove to be a most profitable investment for the industry in the long run as well as assisting in opening up very favourable relations with our Russian electrical friends during the remaining stages of the war if, as appears likely, it lasts much longer.

The Council of the Lord Kitchener National Memorial Fund is founding a number of commercial scholarships for the sons of deceased and disabled officers and for young men who have served with the Forces, for the purpose of enabling them to gain experience in France, Russia, Italy, Japan, Belgium, Roumania, Portugal, and Serbia. Is it altogether out of the question to prepare one grand national scheme by which the textile, engineering, and electrical trades could co-ordinate their efforts in co-operation with the Kitchener Memorial Council?

Rubber.

There has been a little more life in crude rubber within the past fortnight or so, and the market has occasionally shown improvement, though no important advance has to be recorded on balance. The more active demand which has been experienced is chiefly attributed to the misgivings which have been aroused through shipping uncertainties. There has, under the circumstances, been more readiness to cover short contracts outstanding on the part of dealers, but otherwise no eagerness to buy has been seen, consumers being apparently still of opinion that a hand-to-mouth policy is quite in keeping with the heavy stocks now in existence on this side. Stocks, indeed, have grown very considerably the last few months, the total returned at London and Liverpool combined on October 1st being 10,408 tons, which shows an increase of about 4,000 tons and 5,000 tons respectively compared with the same date in the previous two years. There is not much doubt that the accumulation of unsold supplies will proceed further in the present rather indifferent state of the market, for abnormally heavy quantities were shipped from the East in the past month, while the aggregate for the nine months represents 44,302 tons, comparing with 30,657 tons in 1915 and 21,550 tons in 1914. The output of the plantation estates will doubtless continue progressive, although the latest advices from that quarter suggest that operations are now to some extent hindered by labour scarcity, and other adverse causes. The labour problem, at any rate, is causing some apprehension in the Middle East. Therefore, the increase of output in various directions is hardly likely to be as large as originally anticipated, unless the shortcomings referred to can soon be remedied.

The market at about this time last year became extremely sensitive through shipping uncertainties, and delayed arrivals, chiefly because the unsold stocks were comparatively reduced, and the United States were buying freely. At that time a large portion of the rubber arriving here was already sold, and the balance was thus easily taken care of by the additional orders coming on the market for spot rubber. Conditions now are practically reversed. Through the short-sighted policy of the estates in refusing to sell ahead, forward positions have been left rather unprotected, and the result of this policy is that very considerable quantities of the plantation product are arriving unsold. This naturally has a subduing effect upon demand, while manufacturers

already carry fair stocks, and are not keen about increasing their commitments. The prices asked for forward rubber are still considered too high to induce fresh interest. No great reliance can be placed upon America increasing her takings to any important extent until after the Presidential Election, in view of political uncertainty. Meanwhile, however, it may be mentioned that according to the latest advices from that quarter reserve stocks in manufacturers' hands have been eaten into considerably within the last few months, and that the progress of operations at the American mills is quite satisfactory in spite of the recent labour disturbances. Export of rubber goods are in excess of all previous records, and manufacturers of tires are doing a very large business, while rubber goods are being introduced as a substitute for leather soles for shoes, &c. There is no doubt that buying power is accumulating for the raw product, which must eventually lead to more active American buying from the East direct or from this side.

Coal Economy.

Elsewhere in this issue we publish an abstract of an address by Mr. R. A. Chattock to the Birmingham Association of Mechanical Engineers, in which the author, after touching upon various aspects of the engineering industry as affected by the war, on lines with which we are in hearty agreement, took up a subject which for many years has been with him a favourite study—the reform of our methods of generating and distributing electrical energy. In view of the national movement in this direction, and of the fact that he is Chairman of the I.E.E. Committee on Electricity Supply, Mr. Chattock's remarks are particularly interesting and timely.

It will be observed that, with other leading electrical engineers, the author advocates the more complete and efficient utilisation of coal by the one method that is at present open to us—gasification of the crude fuel, and recovery of the products of its distillation which are more valuable in themselves than as sources of heat. Commenting on the enormous amount of coal required to provide sufficient combustible gas by distillation, and the large area that would be occupied by the generating station, Mr. Chattock suggests that some of the boilers should be fired with the coke resulting from the former operation, thus achieving the double object of reducing the amount of coal to be handled, and avoiding the production of excessive quantities of coke "or other form of fuel"—the solid product of the low-temperature distillation of coal being considerably different from what is known as coke. As an alternative, the "coke" might be gasified in producers; this would have the advantages of uniformity in firing the boilers, and avoidance of the difficulties that are met with in burning coke in boiler furnaces, against which must be set the difference between the cost of suitable grates and that of the producers. It is interesting to note that the big gas engine is not so much as mentioned in the address—so completely has the steam turbine established its superiority as a prime mover.

Mr. Chattock includes amongst the benefits derived from the adoption of some such scheme the conservation of our coal supplies, the elimination of smoke from the atmosphere, and the supply of electrical energy at very low prices—all most desirable results. Also, by siting the generating stations at coal mines and transmitting energy electrically, he proposes to relieve the congestion of traffic on the railways, and in order to hasten the change he advocates the adoption of compulsory measures by the Government. To discuss the pros and cons of the last-named course would require more space than we can spare to-day; but with regard to the economy of power supply we may say a few words. It has been fully realised in certain industries that the cost of power in itself is a mere trifle compared with the total costs of production and marketing, and while we would not underestimate the importance even of "mere trifles," we wish to point out that the *saving of labour*, combined with increased output, resulting from the liberal employment of electric power in industry is of far greater moment, and should be given greater prominence in discussing this subject. The importance of this point was marked before the war; in the future, it will be of still greater significance. In connection with heating operations on the other hand—domestic and industrial—the cost of energy is certainly the paramount consideration, and the same is true of electrochemical work, which is likely to come more extensively into vogue.

The electrical station engineer may view with some concern the prospect so frequently displayed before him—that he will have to add to his many accustomed activities the functions of a gas engineer and chemist. We sincerely trust that opposition to reform will not be based upon this ground. There is no inherent reason why he should shrink from such a fate. In any such large undertaking as Mr. Chattock foreshadows there is bound to be a staff of expert chemists, and the engineer will be concerned mainly with the utilisation of the gas supplied by the coal-consuming department, as at Brighton. But it would be well if electrical engineers who hope to attain eminence in electricity supply would take time by the forelock, and make themselves familiar with this branch of the subject—for the change is bound to come.

American Prosperity.

The article on the present position of the electrical industry of the United States, which we quote in full from our American namesake in this issue, will be read with interest—not, perhaps, unmixed with envy—by British manufacturers, who, with all their energies absorbed in the gigantic task of maintaining the cause of a free and beneficent civilisation in Europe against the onslaught of a barbarous and Vandal foe, are for the present unable to take due part in the feast of industry spread out before their confrères. "Feast"—it might rather be called an orgy! It must be admitted, however, that no small part of the trans-Atlantic prosperity is due to the manufacture of munitions of war, which, by the force of circumstances, of which the British Navy is the predominant factor, can be supplied only to ourselves and our Allies, and to that extent our neutral friends are supporting the cause of justice and freedom.

Whether that should be the limit of their military activities it is for them to judge—we have our own opinions on the matter. What mainly concerns us is not so much the present as the future, in this connection. The fact that our manufacturers have, in spite of the most adverse and difficult conditions, succeeded in raising their exports for the last two months to a higher monetary value, if not a greater volume, than in the corresponding months before the war, is of good augury. Our workshops are crammed with machinery, much of which should be capable of adaptation to the requirements of trade after the war, and a new spirit has been inculcated into our industrial armies, from which we hope for great results. The big American firms are clearly quite unable to cope with the volume of business that is now offered them, and when peace looms ahead undoubtedly the world's demand will be redoubled, while the establishment of a preferential régime throughout the Allied nations must prove a vital factor in determining the course of trade. We therefore have no fears for the future, provided that no effort is spared to meet the new conditions with the utmost efficiency and determination.

ELECTRICAL TRADE IN INDIA AFTER THE WAR.

By G. R. DRUMMOND, M.I.E.E., M.I.M.E.

The majority of electrical firms in England at present hardly realise the immense possibilities and importance of electrical progress in India. Up to a very few years before the war very little competition was offered at all by English firms, with the result that many very large orders were placed on the Continent and in America, resulting in foreign firms obtaining a footing in this country, and, in my opinion, it is "up to" British manufacturers to consolidate their present position, and to considerably extend their activities in India—that is, of course, if they wish to compete with foreign firms in this direction. Now I do not wish to imply in the least that what has been mentioned regarding orders being placed abroad was due to weak representation, but to earnestly impress on firms that there appears to be no reason whatever why after the war England should not supply the bulk of electrical goods for India, and that, apart from home orders, their works can be fully employed to cope with this increased business, provided they tackle their Indian export trade in the correct manner. What is the best way to achieve this result? I remember, when I was in London in, I think, 1905, I was talking to the managing director of one of our leading electrical firms, and in the course of our conversation he mentioned that his firm had agents in India, but orders were few and unimportant, and he inquired if, in my opinion, more business would result if direct branches were established and the agency abolished. My reply was emphatically yes, provided you send out the right men and go to work correctly, always remembering the vastness and possibilities of the country. The firm in question took my advice and have done fairly well, but not so well as they might have done, or as I anticipated. Firms operating in India should remember that, generally speaking, business is carried out on completely different lines to those obtaining in England, and that certain points should be carefully observed, of which I will detail what are, in my opinion, the most important:—

Workmanship.—This should be of *the very best always*; in fact, more attention and care should be given by works to orders for India than for home orders. Not, as I am afraid is sometimes the case, machinery pushed through the test house with the remark, "Oh, it's good enough; that machine's for India; we'll not be worried or hear about it, once it's shipped." No; they would possibly not hear much about it, or their firm about repeat orders. Any plant, even if only a little doubtful under test, should be kept back, and, if necessary, scrapped. Firms' reputations have been completely damned for certain classes of work, owing to indifferent workmanship and their test house passing the stuff through as good enough for India. I remember—it was, I think, in 1908—I was inspecting and reporting on an electric scheme in a large Native State, and had been told that the scheme was being changed from D.C. to A.C., and a steam 3,300-volt alternator, with switchboard, had just been installed. I was looking forward to seeing this plant, as it was from old-established English firms with good reputations for D.C. boards and machines, but firms who had up to then manufactured little, if any, A.C. plant. On arrival at the power house with the engineer, some D.C. sets only were in operation, and on my inquiring if the A.C. set could not be started up for my inspection, the engineer replied, "Well, as a matter of fact, we're rather afraid to run it. We have had no luck at all with board or set." On its being uncovered for my inspection, I understood why. Without going into details, I will only say that I recommended the engineer to return the plant to the makers as useless, and on no account to try to operate it. The firms in question possibly heard little about this, for various reasons, but from that date to this I have seen no more of their A.C. plant, nor have I heard of any, being installed in India, and in all probability this has also seriously affected their sale for other electrical material, without the heads of the firms understanding why. This is only one case of many I could quote from my own experience out here. Firms must understand that jobs in India are some 8,000 miles from their works, and engineers out here cannot 'phone up works to send men to inspect, overhaul, &c., &c., or to rectify any fault that may occur, and if any trouble is experienced with plant no repeat orders to that maker are going home, and such news travels. On the other hand, if the plant is really good, many repeat orders result, and, when new works are in progress, engineers invariably specify plant of which they know examples are running satisfactorily in other parts of the country. Another point is, makers should realise that plant which is excellent for England may not always give satisfaction when installed in India, and that plant which would run well, say, in Bombay, would give trouble if installed in Delhi. Extreme climatic variations must always be taken into consideration, and in certain parts of India the prevalence of dust storms have to be considered. Firms should also bear in mind that in all probability the plant will be entirely operated by cheap Indian labour, and they should design same accordingly. Efficiency for home practice is an important factor, but in many cases engineers in India would prefer reliability at the expense of a little efficiency. One other point is, *firms must standardise more.* Possibly many of my readers will say, "We do standardise." To a certain extent I admit, but they should standardise whenever possible, and work strictly to standards, until, of course, the design changes, and then it should always be possible for a machine to be made—if required—to an old pattern to match machinery already installed. Nothing is more annoying than to receive plant which has been specified to be exactly similar in every respect to a previous order arrive out with different fittings, and to be obliged to stock, say, a different size of brush for same, to say nothing of the break up in the uniformity of the station. In my opinion, firms would do well to have attached to their export department a good reliable engineer with a special knowledge of India, whose duty should be examination and passing of all goods for India.

Representatives.—Representatives should preferably be engineers who have had a good varied home training, with also experience in India. They should have plenty of tact, the full confidence of their firms, and, above all, they must be "pucca sahibs," able to move in society, and eligible for membership to any of our clubs.

During my 13 years' experience in India, I have at different times met a good many representatives of firms, who have called on me at my different stations, and of these I suppose there were few indeed who were really suitable men to represent their firms here in India. It must be remembered that at least 50 per cent. of the business is negotiated with Indians, the majority of whom require very tactful handling. Ninety per cent. of these have not seen England, and, therefore, must judge firms, to a certain extent, by their representatives. I will mention here that no one is quicker to observe whether a man is a "chota sahib" (little man, literally subordinate) or a "bara sahib" (big man, literally officer) than an Indian, and be impressed accordingly, or otherwise.

In India there are observed two classes—*i.e.*, the club man (officer class) and the subordinate, and the distinction is most marked. Representatives must, of course, belong to the former (it would be fatal to the interests of their firms for them to drift into the latter), and it is essential that they should belong to the local club and mix in Society. Possibly my readers will say—"Oh, that's absurd. We want a man to push business, not to go into Society." I can assure them that much more business is secured by the man who has entry into the clubs and Society than the man who, say, grinds hard at office all day and talks about having no time for such frivolities. The ideal representative is the man who combines both work and social life, and it must be obvious to my readers that when orders are being handed out—other things, of course, being equal—it is the man one knows and meets at club who generally secures the work. Some representatives of firms, although eligible, cannot belong to clubs, because their pay does not permit. This is a great error on the part of their firms, who, I take it, are ignorant of the country, or they would not handicap their men before they really get to work.

Living in Presidency towns is expensive. For instance,

in Calcutta a suitable house cannot be had under Rs. 500 a month; servants and living expenses run away with another Rs. 500, and then one has club and other expenses, and last, but not least, if the representative is married, comes the yearly expense of wife and family going away to the hills during the hot-weather months.

The above is not by any means exaggerated. One of the many duties of the representative is, at times, to receive and put up clients who may be down on business, and to entertain them. To do this it is essential for him to have a house in a good locality, and, generally speaking, to look after the client, and treat him as well as if he were in his own home. I wonder how many firms there are who pay their representatives only Rs. 750 or under a month, and are under the impression that they are treating their men well? Apart from the fact that good sound men cannot be had for that pay, their men cannot possibly live as they should do, and as is their duty to their firm.

Some years ago I was asked to install a complete modern electrical equipment for a large theatre in a State for which I was then consultant. I was extremely busy at the time with other schemes, so sent full particulars with drawings to a certain firm which I knew had carried out similar work in India, asking for a detailed estimate for the supply of all the material. After a very long wait and some correspondence, the representative stated he would not send the estimate unless I deposited a sum of money with his firm, which would be forfeited if he did not get the work! Needless to say, I placed the order elsewhere, and intended sending the correspondence to the head of the firm, only I realised that it was more the firm's mistake in sending out such a man than that of the representative, who, no doubt, thought he was doing the correct thing.

Representatives should at least once a year tour India, making personal calls on all clients, and paying visits to all native States and towns where electricity is, or is likely to be, installed. This is essential, and it should not be necessary for the representative, on his return to his centre, to have to work at nights to pull up his arrears of office work accumulated during his absence. How many times have letters been forwarded to clients, stating that the representative was "up to his eyes in work, and could not possibly get away before such and such a date." This is altogether wrong, as the representative should so arrange his office routine as to leave himself free to take a trip anywhere at a moment's notice, without feeling worried at the thought of work piling up for him against his return. He should remember that he is not serving the best interests of his firm by becoming an office fixture.

To conclude, I will add that in the first five years after the war, it is certain some millions sterling will be spent on electrical work in India. Apart from the innumerable smaller schemes pending, two great industrial schemes are to be launched by, or through, the agency of Messrs. Tata, Sons & Co. First of these is a hydro-electric scheme with a capital of 2½ crores of rupees, and the second an extension of Messrs. Tata's steel works, at a cost of 3½ crores of rupees. The activities of Sir Thomas Holland and his Commission will do much to stimulate trade, and altogether the future holds out vast possibilities for electrical enterprise in India. I sincerely trust our English firms will take full advantage of them, and that these few notes will be of some little assistance to them in this direction.

THE PRESENT STATUS OF THE AMERICAN ELECTRICAL INDUSTRY.*

The vast volume of business now being handled by the Westinghouse Electric & Manufacturing Co. and the General Electric Co. has never been paralleled in the history of these manufacturers. The two companies are taking orders this year at the rate of $225,000,000 per annum, which is $90,000,000, or 65 per cent., in excess of any other year in their corporate existence. According to a statement in the *Wall Street Journal*, the Westinghouse Co. will manufacture during the fiscal year to March 31st, 1917, including its shell orders and other munition orders, aside from rifles, between $90,000,000 and $100,000,000 of finished products.

Those who have studied the condition of the electrical industry in the United States during recent weeks have been amazed at the sold-up condition of great concerns like the Westinghouse and General Electric. It is understood that in the turbine departments of both these big producers no deliveries of turbines short of 18 months are being promised. In fact, some very large contracts have been taken this week, calling for 18 months' delivery. In other lines Westinghouse is sold ahead at capacity for seven and eight months, and the same statement is true of General Electric. These two companies have orders in hand for 20,000 to 25,000 motors alone.

Because of the immense pressure which incoming orders are exerting, Westinghouse Electric has purchased 500 acres of land on the Delaware River, and will use it as the nucleus of a new manufacturing centre. The physical possibilities in its East Pittsburg location are so clearly exhausted that it was imperative that a new centre be started if the company is to continue to hold its normal proportion of the industry.

Indicative of the prosperity of the manufacturers of electrical equipment and the entire electrical industry, but teeming with the difficulties encountered by manufacturers, were addresses made by G. E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Co., and E. W. Rice, Jun., president of the General Electric Co., before the Association of Edison Illuminating Companies, at its 37th convention at Hot Springs, Va., September 5th/7th. The excerpts from these addresses serve admirably to show the conditions now existing in the manufacturing branch of the industry.

Abstract of Mr. Tripp's Address.

In order to get a comprehensive view of present manufacturing conditions in the electrical industry, it is necessary to review for a moment a little of its past history. When the electrical industry began it was something more than the mere selling of a manufactured product. It was the application of scientific knowledge to practical uses, and required close co-operation between the manufacturer and the pioneers in the public utility field.

The tremendous importance of individual genius was the predominating feature of this period, and manufacturing was largely confined to the development of the particular apparatus which some far-seeing man had invented or developed. As a natural consequence, the same man became an indispensable factor in the application of his conceptions to the public use; and from this condition arose, not electrical manufacturers, as they are now constituted, but organisations standing sponsor for and producing goods according to systems developed by the great chiefs of the electrical science. Through these agencies there sprang up a great number of small installations of street railways and electric light companies, serving the routine local wants of the ordinary citizen in his daily life. This was the first step in the evolution of the industry.

Perhaps the next stage may be described as that in which the various systems were sifted out, not, however, by the predominance of one or the other, but as is usual in such circumstances by a combination of the best points of all of them, until the manufacture of electrical apparatus and the application of it became more or less standardised. That is to say, while invention and research went on, and is still going on, and important improvements were from time to time made, and are being made, it is a fact that the large manufacturer of electrical apparatus can and does produce machinery and apparatus that is adapted to any kind of electrical service.

When the manufacture of electrical apparatus had reached this stage it made possible the new era of central-station development, which resulted in a great expansion of the uses of electricity, the history of which has been a matter of comparatively few years. The isolated electric light plant which had no power business and gave a local individual service which had no great fluctuations, has passed away and has been replaced by huge central-station organisations which sell a great percentage of their output for uses in all lines of industrial activity, and whose business will more and more tend to rise or fall with the general tide of industry.

The demand for large generating units has been greatly increased, due to the more intelligent and energetic conduct of the electrical business under concentrated control, for it is an undoubted fact that scientific management keeps pace with concentration. I believe that the tendency for combination and consolidation of public utilities is bound to go on from a purely economic standpoint, and that this irresistible tendency will present many political problems for solution, but I have referred to them solely for the purpose of enabling you to better understand that the demands from the manufacturer, brought about by the sudden and tremendous impetus given to almost every branch of industry in the United States on account of the European War, was the combined result of these great aggregations and the large use made of them by industrial enterprises. That is to say, manufacturing industries of all kinds, which have been recently taught to use electricity as a power, called for an increase in service, the magnitude of which was as unforeseen as it was abrupt.

* *Electrical Review and Western Electrician*, September 23rd.

The experience of our company will serve to illustrate how sudden and unexpected was the demand made on the manufacturing industries of this country during the latter part of 1915. The war began August 1st, 1914. At that time we had unfilled orders on our books of about $8,000,000. This was a small amount, and represents about two months theoretical full output of our shops. The outlook was anything but encouraging. On February 28th, 1915, which was the lowest point we reached, we had on our books approximately $5,600,000 of unfilled orders, a falling off of 30 per cent. Our shops were running at not over 50 per cent. capacity, and the total number of men on our pay roll was about 14,800.

While February, 1913, was the low period, there was not great improvement for several months afterward. In fact, the real upward movement did not begin until November 1st, 1915, at which date we had on our books $8,900,000 of unfilled orders. In order that you may have these figures more clearly in mind, let me recapitulate. On August 1st, 1914, at the beginning of the war, we had on hand $7,900,000 orders. On February 28th, 1915, which was our low period, we had on hand $5,580,000. On October 31st, 1915, or 14 months after the beginning of the war, which marked the real beginning of the avalanche, we had on hand $8,900,000. From that time on there was no cessation of increases. Notwithstanding we increased our forces from the figure of 14,800 to nearly 30,000, and ran our factories to the fullest possible capacity, we have on hand to-day unfilled orders for electrical goods amounting to considerably over $30,000,000.

In all these figures I have given I have taken no account whatever of orders for war munitions. I am referring to our regular product, in which, as you have seen, notwithstanding the very large output of our shops during the last eight months, our unfilled orders have increased over the low point of February, 1915, by almost 600 per cent.

I have no figures at hand giving statistics as to the demand for labour upon the munition industry, but I should hazard a guess that 150,000 or 200,000 new jobs would not be excessive; and, as the number of men we have employed on munition work amounts to about 4,500 in Pittsburgh, it is fair to say that our labour conditions would have been just as serious had we never taken a war order. Our greatest task is to find a sufficient supply of the two extremes, viz., the highly skilled and the common labourer. The first is practically unobtainable, and the latter is becoming scarcer, more expensive, and less efficient. It is not difficult to hire enough men, but they will not stay.

Up to this point I have endeavoured to outline some of the conditions under which we are now working, but I should like to add something from the financial and profit side, and to say at the outset that, under normal conditions now and in the future, so far as I can foresee, an electrical manufacturer will not be able to earn any more than a fair return upon the actual cash invested in the business; that is to say, no cash returns are to be expected upon patent rights, good will, and other intangibles of that nature. It may be possible for a concern to do it for a few years, but it will be because an insufficient amount is being expended in research and development work, and that policy carried on long enough will eventually put any electrical manufacturer out of business. We expended last year in research and development over $1,000,000, and that amount, of course, comes bodily out of net earnings, because it is an expenditure that cannot bear immediate fruit, and it would only be warranted on the expectation that the general law of averages over a period of years would in a thousand ways add that and more to the money value of the company's business.

The profits in the business are undoubtedly close. I think our shops are operated with reasonable efficiency, and I think our sales department gets as high a price for the product as possible, but until last year, which included war profits, there has never been a year in the last ten years that the Westinghouse Electric & Manufacturing Co. made as high as 15 per cent. on the selling prices of its output. The figures have ranged from 8 per cent. minimum to 14 per cent., with an average of, say, 12.5 per cent.

This is a close operation, and requires that, for safety, a manufacturing company should turn its capital over once a year, and where it has not yet reached that desirable stage it is undoubtedly wise policy to constantly increase its reserves until the goal has been attained, and the Westinghouse Co. has pursued, and will pursue, that general policy so far as it is able to do it.

Abstract of Mr. Rice's Address.

The situation in regard to general manufacturing conditions is, from a production standpoint, extremely unsatisfactory. Stocks in the hands of manufacturers and dealers in metals and machinery, which were allowed to become depleted, owing to the abnormal reduction in business, were quickly exhausted upon its revival. All manufacturers and dealers in such materials and appliances soon became overwhelmed with orders, and consequently there has been for the past year, and still continues to be, the greatest difficulty in obtaining raw materials and equipment, particularly those of a special nature. The demand for copper and brass materials, iron and steel, sheet steel, castings, forgings, &c., has for some time greatly exceeded the capacity of the producing concerns in this country. Promises made by producers of raw materials and machinery and tools, of every description, have been found, by sad experience, to be extremely unreliable, and this naturally interferes with our schedules of manufacture of finished goods. There is little, if any, evidence of a change in the situation in the immediate future, and we anticipate that difficulties will continue to be experienced in obtaining raw materials. As a result of over-sold conditions prices have been advanced to unprecedented figures.

The increase in prices of raw materials and machinery has not been permitted to directly affect production unfavourably, as these prices have been met. The fundamental difficulty which has constantly interfered with production schedules has been the inability to get machinery and materials, either on time or in sufficient quantities to keep our factories operating in an efficient manner. In some instances materials and machinery which heretofore have been employed have been unobtainable, and new materials, machinery, and methods have been substituted, all of which has involved delay in production. Even after we had succeeded in purchasing our raw materials, and shipment had actually taken place at the point of manufacture, there was no assurance that the material would arrive on time. The railroads, as is well known, became so congested that deliveries were slow and uncertain, and complete embargoes were frequently placed upon the delivery of important materials, and always, it would seem, at the most unfortunate time for ourselves and our customers.

The manufacturer, however, needs something more than buildings, machinery, and raw materials in order to fill the orders of his customers. He must have labour of good quality and of reasonable and reliable supply, and, manifestly, it is impossible to cope with the increased volume of business without an increase in the efficiency of labour, or an increase in quantity. In spite of all our efforts the labour situation for the last year has been, and still remains, in a very unsatisfactory condition, especially with reference to high-grade skilled employés and low-grade common labourers. There does not seem to be a sufficiency of either class to meet the demands of production in this country. As is well known, the scale of wages of such employés is abnormally high, which condition has been intensified by competition among the manufacturers themselves.

The increase in the price of labour would not in itself affect production adversely; it might, in fact, under proper conditions, lead to a stimulation and improvement of production. However, unfortunately, there is every evidence that the efficiency has, temporarily at least, declined, and the output per man is lower than it has been heretofore at a time when it is to the interest of all men engaged in the industry, as well as the employers, to obtain the highest possible output.

The large contracts which have been taken for war munitions have unquestionably affected the general manufacturing situation. They have created a demand for enormous quantities of brass, copper, and steel, and are largely responsible for the condition in which the producers of such materials find themselves, viz., almost complete inability to fill orders.

As to what extent, if any, the manufacture of munitions by our company has interfered or may interfere with deliveries of our regular products, I frankly admit at once that such contracts as we have taken for munitions have interfered, and will, until completed, interfere to a relatively limited extent with our regular business. I may further confess that if we had anticipated the prompt revival of business, to say nothing of the phenomenal increases in our regular business, we would never have undertaken the manufacture of any munitions.

At this time it is difficult to express a definite opinion as to the deliveries on 1917 contracts. We have taken large contracts for delivery in 1917, and in some cases even for 1918. We are contracting for important materials as far in advance as seems to be necessary, in order to ensure deliveries. In order to be assured of a supply it seems to be necessary to place orders for some materials well into 1917. In such cases we have not hesitated to take the risk.

The great increase in the cost of raw materials and labour, as well as other items of expense, have made it necessary for us to increase our prices. We have not, however, advanced our prices more than necessary to cover increased cost of manufacture. In some classes of apparatus, through the skill of our engineers in re-designing, without sacrifice of quality, we have effected economies off-setting, in part, at least, the normal increase cost, and in such instances our prices have not been increased to the extent that otherwise would have been necessary.

As to future prices, we are so completely dependent upon the prices which we must pay for raw materials and labour that it is impossible for us to express an opinion which would be of special value. It would almost seem that the high-water mark, with respect to prices of raw materials and labour, has been reached, and, if so, with a continuance of such conditions, future prices of our materials would naturally remain substantially unchanged. Of course, upon any extended reaction in business, which some authorities assure us will take place upon the cessation of hostilities, prices would naturally decline.

It has been suggested that the large profits on munition contracts have established a precedent which may have a bearing upon the electrical business. I do not share in this view, as the electrical business is highly competitive, and in normal times the volume of demand is less than the combined facilities of all the manufacturers.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Sanders Fuseboards.

Messrs. Wm. Sanders & Co., of Falcon Electrical Works, Wednesbury, are introducing a new skeleton type of fuseboard, the construction of which does away with the usual china or slate base. The contacts are supported direct by bus-bars and insulated bars which carry the terminal contacts; the contacts are clamped direct to the bus-bars by the firm's patent clip system, the terminal contacts being mounted on a bar insulated with moulded mica.

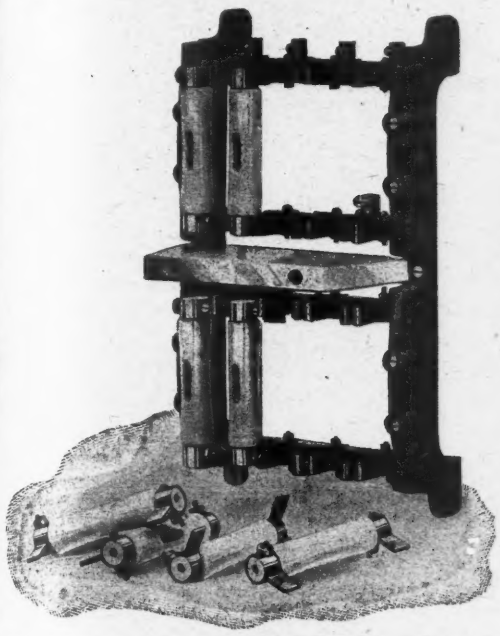

Fig. 1.—Arrangement of Sanders Fuses and Terminals.

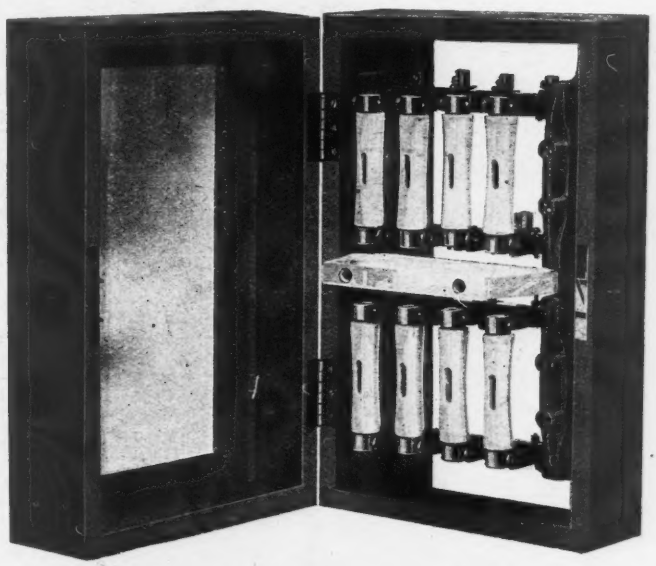

Fig. 2.—Sanders Fuseboard and Case.

The bars—terminal and bus—are supported at their ends by a rigid iron frame, being insulated from the latter; the main terminals (on the patent clip system) can be clamped anywhere on the bus-bar between the contacts. Figs. 1 and 2 show the skeleton construction of the fuse frame and the latter fixed in a case.

It will be noted that the panel can be wired up without dismantling and that the cables can be run up and down direct to the terminals without any bend. The live parts are all mica insulated, and the construction is claimed to be practically unbreakable and therefore ideal for transit.

Ediswan H_2O Cells.

The Edison Swan Electric Co., Ltd., of Ponder's End, has brought out a new and improved type of its "H_2O" cell, which is a small and compact cell turned out dry and made active by the addition of water only. Fig. 3 is a cross-section of the cell, which is provided with a clear glass container, A; a porcelain base B, fixed in position with melted bitumen, forms a support for the sack C, and for the zinc cylinder D, keeping them always the correct distance apart, yet so close together that the internal resistance is very low. A rubber ring E, is a further safeguard against accidental contact. Above the sack is a porcelain ring F, slipped over the carbon rod G, and supporting a waxed cardboard washer H, on which the sealing compound is poured. A fibre tube passing through the compound and closed with a cork, enables the cell to be filled with water and a small glass tube provides an outlet for the gases generated when the cell is in use. A lead connection strip J is soldered to the zinc cylinder, and a brass cap K forced on the carbon rod, carries the screw terminal. Ammonium chloride crystals L are placed in the cell at the time of manufacture. Provision can be made on the label for recording the visits of inspectors, and the cells, when worn out, can be recharged by the makers.

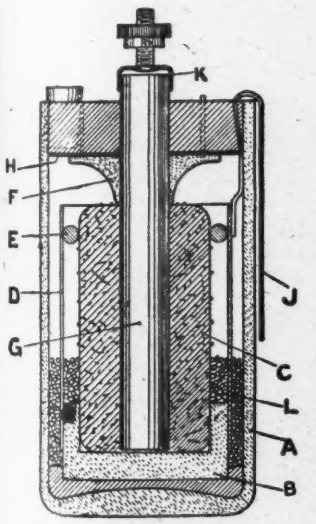

Fig. 3.—Ediswan H_2O Cell.

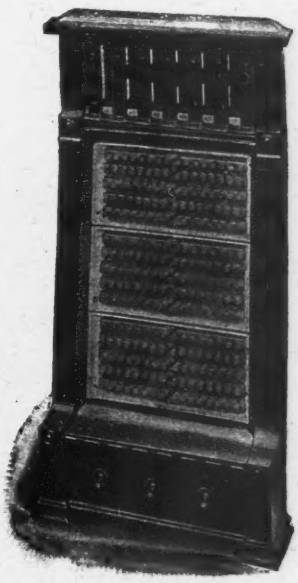

Fig. 4.—Carron Electric Fire.

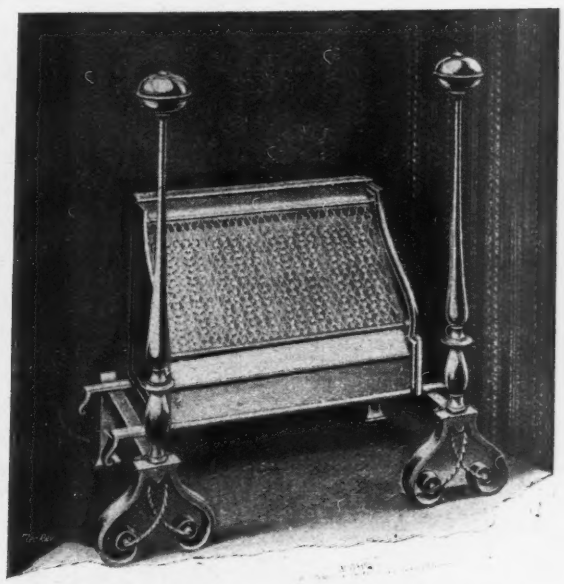

Fig. 5.—Carron Dog Fire with Electric Heaters.

Carron Electric Fires.

Amongst the various designs of electric stoves, fires, &c., contained in the recently issued pamphlet E.F. 4, of Carron Co., may be mentioned a series of fire interiors specially designed to take the place of the ordinary coal fire grate, but which do not require building in. All these fires are fitted with three or four standard patent Carron radiant electric fire bars, each of 1 kw. capacity and controlled by a separate switch. The design is such as to heat the air which circulates through the fire; the stoves can be supplied in art black, armour bright or electro-brass or bronze finish, and be fitted with trivets. Several patterns of independent electric fires are also listed, of which fig. 4 represents a typical design, with three heating elements separately controlled and giving a total loading of 3,000 watts; smaller 2,000-watt fires are also made. The elements are all interchangeable and guaranteed for two years.

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The experience of our company will serve to illustrate how sudden and unexpected was the demand made on the manufacturing industries of this country during the latter part of 1915. The war began August 1st, 1914. At that time we had unfilled orders on our books of about $8,000,000. This was a small amount, and represents about two months theoretical full output of our shops. The outlook was anything but encouraging. On February 28th, 1915, which was the lowest point we reached, we had on our books approximately $5,600,000 of unfilled orders, a falling off of 30 per cent. Our shops were running at not over 50 per cent. capacity, and the total number of men on our pay roll was about 14,800.

While February, 1913, was the low period, there was not great improvement for several months afterward. In fact, the real upward movement did not begin until November 1st, 1915, at which date we had on our books $8,900,000 of unfilled orders. In order that you may have these figures more clearly in mind, let me recapitulate. On August 1st, 1914, at the beginning of the war, we had on hand $7,900,000 orders. On February 28th, 1915, which was our low period, we had on hand $5,580,000. On October 31st, 1915, or 14 months after the beginning of the war, which marked the real beginning of the avalanche, we had on hand $8,900,000. From that time on there was no cessation of increases. Notwithstanding we increased our forces from the figure of 14,800 to nearly 30,000, and ran our factories to the fullest possible capacity, we have on hand to-day unfilled orders for electrical goods amounting to considerably over $30,000,000.

In all these figures I have given I have taken no account whatever of orders for war munitions. I am referring to our regular product, in which, as you have seen, notwithstanding the very large output of our shops during the last eight months, our unfilled orders have increased over the low point of February, 1915, by almost 600 per cent.

I have no figures at hand giving statistics as to the demand for labour upon the munition industry, but I should hazard a guess that 150,000 or 200,000 new jobs would not be excessive; and, as the number of men we have employed on munition work amounts to about 4,500 in Pittsburgh, it is fair to say that our labour conditions would have been just as serious had we never taken a war order. Our greatest task is to find a sufficient supply of the two extremes, viz., the highly skilled and the common labourer. The first is practically unobtainable, and the latter is becoming scarcer, more expensive, and less efficient. It is not difficult to hire enough men, but they will not stay.

Up to this point I have endeavoured to outline some of the conditions under which we are now working, but I should like to add something from the financial and profit side, and to say at the outset that, under normal conditions now and in the future, so far as I can foresee, an electrical manufacturer will not be able to earn any more than a fair return upon the actual cash invested in the business; that is to say, no cash returns are to be expected upon patent rights, good will, and other intangibles of that nature. It may be possible for a concern to do it for a few years, but it will be because an insufficient amount is being expended in research and development work, and that policy carried on long enough will eventually put any electrical manufacturer out of business. We expended last year in research and development over $1,000,000, and that amount, of course, comes bodily out of net earnings, because it is an expenditure that cannot bear immediate fruit, and it would only be warranted on the expectation that the general law of averages over a period of years would in a thousand ways add that and more to the money value of the company's business.

The profits in the business are undoubtedly close. I think our shops are operated with reasonable efficiency, and I think our sales department gets as high a price for the product as possible, but until last year, which included war profits, there has never been a year in the last ten years that the Westinghouse Electric & Manufacturing Co. made as high as 15 per cent. on the selling prices of its output. The figures have ranged from 8 per cent. minimum to 14 per cent., with an average of, say, 12.5 per cent.

This is a close operation, and requires that, for safety, a manufacturing company should turn its capital over once a year, and where it has not yet reached that desirable stage it is undoubtedly wise policy to constantly increase its reserves until the goal has been attained, and the Westinghouse Co. has pursued, and will pursue, that general policy so far as it is able to do it.

Abstract of Mr. Rice's Address.

The situation in regard to general manufacturing conditions is, from a production standpoint, extremely unsatisfactory. Stocks in the hands of manufacturers and dealers in metals and machinery, which were allowed to become depleted, owing to the abnormal reduction in business, were quickly exhausted upon its revival. All manufacturers and dealers in such materials and appliances soon became overwhelmed with orders, and consequently there has been for the past year, and still continues to be, the greatest difficulty in obtaining raw materials and equipment, particularly those of a special nature. The demand for copper and brass materials, iron and steel, sheet steel, castings, forgings, &c., has for some time greatly exceeded the capacity of the producing concerns in this country. Promises made by producers of raw materials and machinery and tools, of every description, have been found, by sad experience, to be extremely unreliable, and this naturally interferes with our schedules of manufacture of finished goods. There is little, if any, evidence of a change in the situation in the immediate future, and we anticipate that difficulties will continue to be experienced in obtaining raw materials. As a result of over-sold conditions prices have been advanced to unprecedented figures.

The increase in prices of raw materials and machinery has not been permitted to directly affect production unfavourably, as these prices have been met. The fundamental difficulty which has constantly interfered with production schedules has been the inability to get machinery and materials, either on time or in sufficient quantities to keep our factories operating in an efficient manner. In some instances materials and machinery which heretofore have been employed have been unobtainable, and new materials, machinery, and methods have been substituted, all of which has involved delay in production. Even after we had succeeded in purchasing our raw materials, and shipment had actually taken place at the point of manufacture, there was no assurance that the material would arrive on time. The railroads, as is well known, became so congested that deliveries were slow and uncertain, and complete embargoes were frequently placed upon the delivery of important materials, and always, it would seem, at the most unfortunate time for ourselves and our customers.

The manufacturer, however, needs something more than buildings, machinery, and raw materials in order to fill the orders of his customers. He must have labour of good quality and of reasonable and reliable supply, and, manifestly, it is impossible to cope with the increased volume of business without an increase in the efficiency of labour, or an increase in quantity. In spite of all our efforts the labour situation for the last year has been, and still remains, in a very unsatisfactory condition, especially with reference to high-grade skilled employés and low-grade common labourers. There does not seem to be a sufficiency of either class to meet the demands of production in this country. As is well known, the scale of wages of such employés is abnormally high, which condition has been intensified by competition among the manufacturers themselves.

The increase in the price of labour would not in itself affect production adversely; it might, in fact, under proper conditions, lead to a stimulation and improvement of production. However, unfortunately, there is every evidence that the efficiency has, temporarily at least, declined, and the output per man is lower than it has been heretofore at a time when it is to the interest of all men engaged in the industry, as well as the employers, to obtain the highest possible output.

The large contracts which have been taken for war munitions have unquestionably affected the general manufacturing situation. They have created a demand for enormous quantities of brass, copper, and steel, and are largely responsible for the condition in which the producers of such materials find themselves, viz., almost complete inability to fill orders.

As to what extent, if any, the manufacture of munitions by our company has interfered or may interfere with deliveries of our regular products, I frankly admit at once that such contracts as we have taken for munitions have interfered, and will, until completed, interfere to a relatively limited extent with our regular business. I may further confess that if we had anticipated the prompt revival of business, to say nothing of the phenomenal increases in our regular business, we would never have undertaken the manufacture of any munitions.

At this time it is difficult to express a definite opinion as to the deliveries on 1917 contracts. We have taken large contracts for delivery in 1917, and in some cases even for 1918. We are contracting for important materials as far in advance as seems to be necessary, in order to ensure deliveries. In order to be assured of a supply it seems to be necessary to place orders for some materials well into 1917. In such cases we have not hesitated to take the risk.

The great increase in the cost of raw materials and labour, as well as other items of expense, have made it necessary for us to increase our prices. We have not, however, advanced our prices more than necessary to cover increased cost of manufacture. In some classes of apparatus, through the skill of our engineers in re-designing, without sacrifice of quality, we have effected economies off-setting, in part, at least, the normal increase cost, and in such instances our prices have not been increased to the extent that otherwise would have been necessary.

As to future prices, we are so completely dependent upon the prices which we must pay for raw materials and labour that it is impossible for us to express an opinion which would be of special value. It would almost seem that the high-water mark, with respect to prices of raw materials and labour, has been reached, and, if so, with a continuance of such conditions, future prices of our materials would naturally remain substantially unchanged. Of course, upon any extended reaction in business, which some authorities assure us will take place upon the cessation of hostilities, prices would naturally decline.

It has been suggested that the large profits on munition contracts have established a precedent which may have a bearing upon the electrical business. I do not share in this view, as the electrical business is highly competitive, and in normal times the volume of demand is less than the combined facilities of all the manufacturers.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Sanders Fuseboards.

Messrs. Wm. Sanders & Co., of Falcon Electrical Works, Wednesbury, are introducing a new skeleton type of fuseboard, the construction of which does away with the usual china or slate base. The contacts are supported direct by bus-bars and insulated bars which carry the terminal contacts; the contacts are clamped direct to the bus-bars by the firm's patent clip system, the terminal contacts being mounted on a bar insulated with moulded mica.

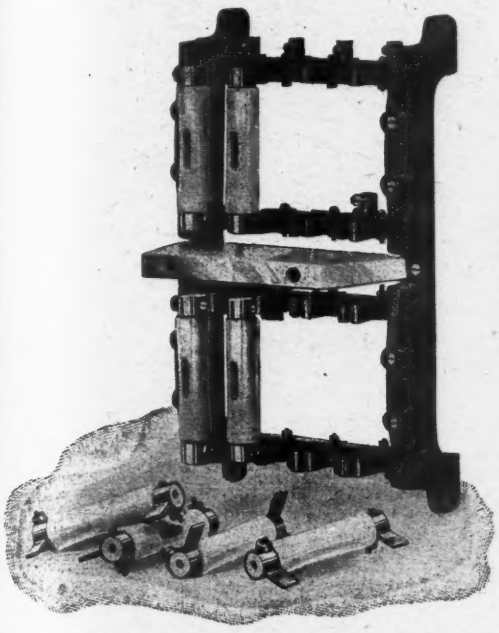


Fig. 1.—Arrangement of Sanders Fuses and Terminals.

The bars—terminal and bus—are supported at their ends by a rigid iron frame, being insulated from the latter; the main terminals (on the patent clip system) can be clamped anywhere on the bus-bar between the contacts. Figs. 1 and 2 show the skeleton construction of the fuse frame and the latter fixed in a case.

It will be noted that the panel can be wired up without dismantling and that the cables can be run up and down direct to the terminals without any bend. The live parts are all mica insulated, and the construction is claimed to be practically unbreakable and therefore ideal for transit.

Ediswan H_2O Cells.

The Edison Swan Electric Co., Ltd., of Ponder's End, has brought out a new and improved type of its "H_2O" cell, which is a small and compact cell turned out dry and made active by the addition of water only. Fig. 3 is a cross-section of the cell, which is provided with a clear glass container, A; a porcelain base B, fixed in position with melted bitumen, forms a support for the sack C, and for the zinc cylinder D, keeping them always the correct distance apart, yet so close together that the internal resistance is very low. A rubber ring E, is a further safeguard against accidental contact. Above the sack is a porcelain ring F, slipped over the carbon rod G, and supporting a waxed cardboard washer H, on which the sealing compound is poured. A fibre tube passing through the compound and closed with a cork, enables the cell to be filled with water and a small glass tube provides an outlet for the gases generated when the cell is in use. A lead connection strip J is soldered to the zinc cylinder, and a brass cap K forced on the carbon rod, carries the screw terminal. Ammonium chloride crystals L are placed in the cell at the time of manufacture. Provision can be made on the label for recording the visits of inspectors, and the cells, when worn out, can be recharged by the makers.

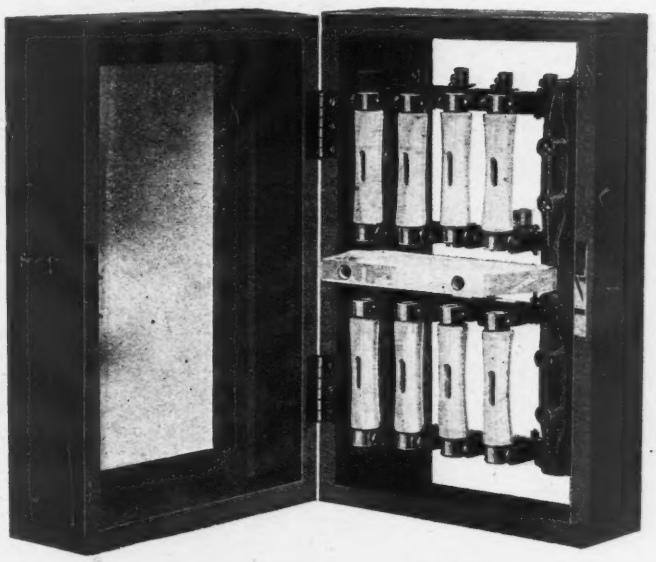


Fig. 2.—Sanders Fuseboard and Case.

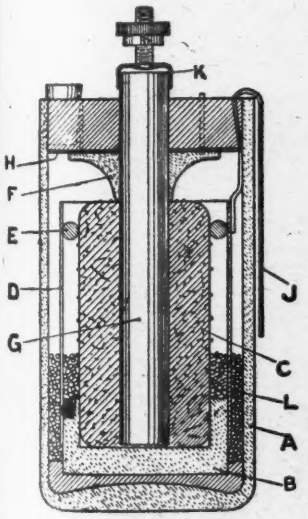


Fig. 3.—Ediswan H_2O Cell.

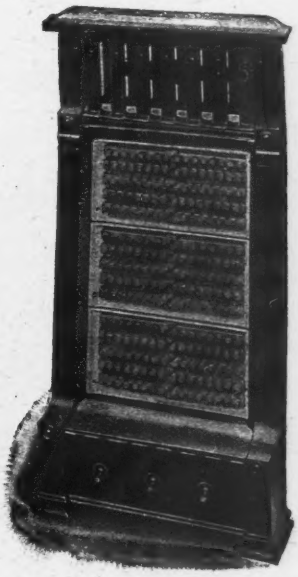


Fig. 4.—Carron Electric Fire.

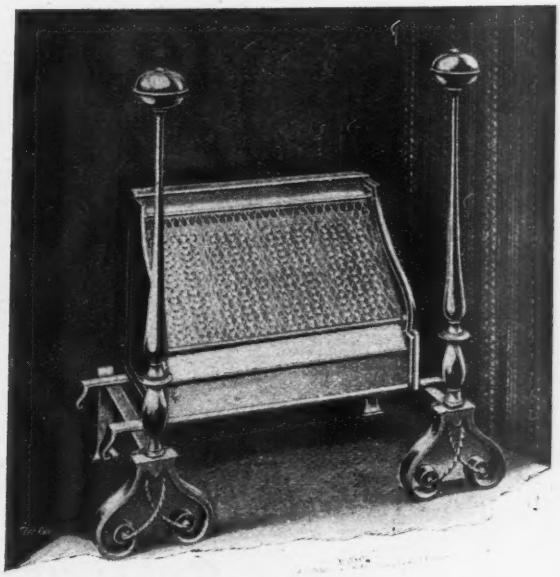


Fig. 5.—Carron Dog Fire with Electric Heaters.

Carron Electric Fires.

Amongst the various designs of electric stoves, fires, &c., contained in the recently issued pamphlet E.F. 4, of Carron Co., may be mentioned a series of fire interiors specially designed to take the place of the ordinary coal fire grate, but which do not require building in. All these fires are fitted with three or four standard patent Carron radiant electric fire bars, each of 1 kw. capacity and controlled by a separate switch. The design is such as to heat the air which circulates through the fire; the stoves can be supplied in art black, armour bright or electro-brass or bronze finish, and be fitted with trivets. Several patterns of independent electric fires are also listed, of which fig. 4 represents a typical design, with three heating elements separately controlled and giving a total loading of 3,000 watts; smaller 2,000-watt fires are also made. The elements are all interchangeable and guaranteed for two years.

D

Another interesting design is the No. 263 dog grate shown in fig. 5, which it will be noted is also fitted with four standard Carron 1,000-watt heaters, which are remote controlled. The dogs are fine examples of turnery and can be supplied in old brass or bronze with wrought iron scrolls and back irons. The company has over a hundred different types of dog grates, designed to suit all periods, which can be adapted to electric heating.

Carron Co. also supply a neat little stove of 1,500 watts loading, specially designed for medium voltage, A.C. circuits in crane cabins and similar positions, and another stove of lesser loading (800 watts), made in cast iron, for heating on ships, trains, cars, and in garages.

The "Wilkinson" Brake.

At the Congress of the Tramways and Light Railways Association on June 30th last, reference was made to a new brake which has been introduced by Mr. R. H. Wilkinson, general manager of the Huddersfield Corporation Tramways. This brake is a band brake attached to the extended armature shaft, actuated through levers from the usual platform brake spindle.

The brake drum, which is of cast-iron and keyed on to the armature shaft, is of open section, the arms creating a draught which assists greatly in keeping the drum cool, also reducing to a minimum the mass of the drum wheel to facilitate rapid cooling. The brake band is of mild steel lined with "ferrodo," and is in one length, attached at the ends to a bell crank lever by means of riveted lugs, one end being fitted with an adjusting screw. The band and levers are supported by an angle iron and flat bar frame attached to the motor suspension bar, and to the motor shell at the axle bearing. A pull-off spring, and adjusting screws for regulating the clearance between drum and band, are fitted to the frame as shown.

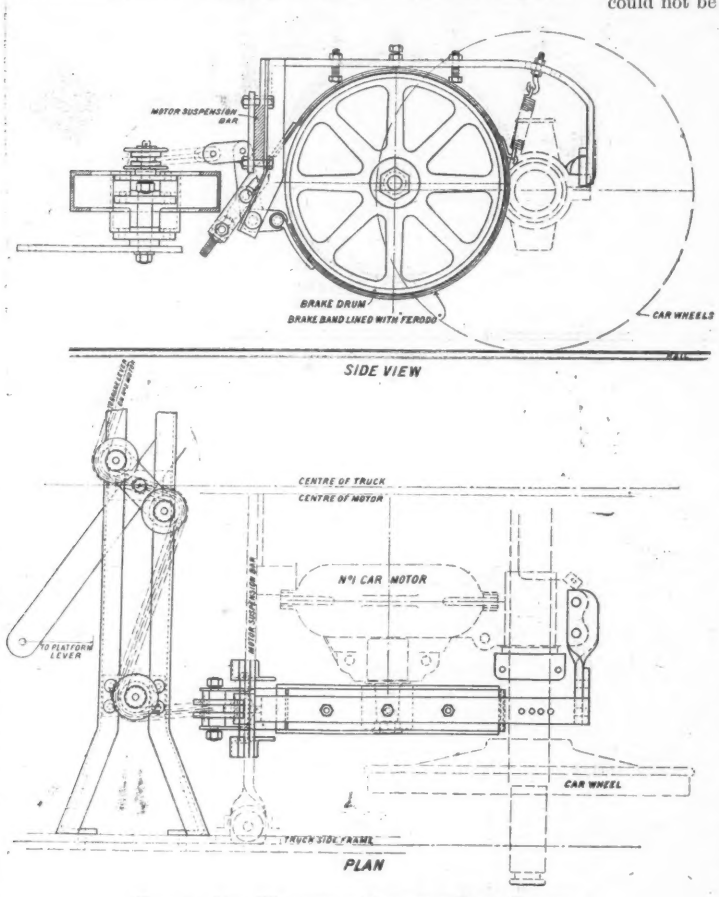


Fig. 6.—The Wilkinson Tramway Band Brake.

The force applied to the brake-band levers is equalised by a differentiating chain gear. A chain passes freely through two fixed pulleys attached to a cross frame, and two pulleys attached to a short lever which is fixed to the main "pull" lever as shown, and moves with it. The "pull" lever is placed on the under side of the cross frame, owing to lack of clearance above, and is connected by a gudgeon to the short "pulley" lever situated above the frame. The ends of the "pull" lever are connected up to the platform brake spindle in the usual way, a hand wheel being used in preference to a lever.

The brake is quickly applied, there being practically no slack to take up, as with wheel brakes. Braking through the gears, it is similar in action to the electric brake, and has proved very efficient.

We are indebted to the *Journal* of the Tramways and Light Railways Association for our particulars and illustration.

THE BRITISH ASSOCIATION.—VII.

Standardisation and the Engineering Industries.

In a paper read before Section G by Mr. C. le Maistre, General Secretary of the Engineering Standards Committee, the assistance rendered by standardisation to the engineering industries was discussed. The author, after referring to the necessity for the adoption of order and system in methods of production, and the consequent movement towards co-ordination and collective effort in place of our former individualistic methods, pointed out the importance of continuous progress and of avoiding any tendency towards crystallisation of design by constant revision of the standards. "Satisfactory results have been arrived at not by one section of the community imposing its opinions on the other, but rather as the result of co-operative action, mutual concession and ultimate agreement between all the interests concerned. The adoption of standards agreed on in this way undoubtedly promotes uniformity of practice, avoidance of waste, elimination of harsh and unnecessary conditions, reduction of manufacturing costs, and last, but by no means least, engenders a feeling of mutual confidence between user and producer such as could not be secured by isolated action on the part of either."

Mr. le Maistre outlined the growth of the Engineering Standards Committee from the inception of the movement by Sir John Wolfe Barry in 1897, to the present organisation of 64 committees and sub-committees, and numerous panels, including in all over 500 members. He paid a tribute to the work of his predecessor, Mr. Leslie Robertson, to whom the success of the Committee was largely due.

As stated in the paper, not only are all parties concerned with any particular subject consulted before a decision is made, but also in some cases experimental investigations are carried out at the instance of the Committee by the National Physical Laboratory.

The British standard specifications, which are confined to the main technical clauses necessary for the purchase of the product to which the specification relates, are being increasingly adopted throughout the country, in home and export trade in general, and are also being largely substituted for the various and differing Government and municipal specifications formerly employed. They are proving of increasing value to the Crown Agents for the Colonies and the self-governing Dominions, and are, in large numbers, being sent abroad for use in the supply of engineering material required.

One of the first objects in the formation of the Committee was to simplify the rolling of steel sections for engineering structures and rails as well as shipbuilding material, so as to save unnecessary cutting of a variety of rolls for no good reason, and also to facilitate the making to stock during slack times. That the work of the Committee in this direction has been amply rewarded is shown by the fact that the number of rolls in use by British manufacturers has been largely reduced. As an instance, whereas there were formerly 70 sections of tramway rails, there are now only five. The same is true of all ordinary merchantable sections, such as angles, tees, and channels and rolled joists. The percentage of British standard tramway rails to the total tonnage rolled during the year ending March, 1915, was 75 per cent., which is an indication that the number of standards recommended is adequate to meet all ordinary requirements. A considerable reduction has similarly been effected in regard to railway rails. The railway companies, Government Departments, the London County Council, and other important bodies both at home and abroad, have adopted many of the Committee's standards.

Turning to the electrical side of the Committee's activities, a large amount of preparatory work of importance has been successfully carried through during the past two years. The most important electrical work completed is that of the Standardisation Rules for Electrical Machinery, in the preparation of which the Committee has received the cordial co-operation of the British manufacturers through their official organisation.

The conditions of the electrical industry in this country, says Mr. le Maistre, are very different from those existing either in Germany or America. In the United States two large corporations deal with practically the whole of the business, whereas here there are some 40 or 50 firms more or less in competition with one another. However, conferences held both in London and in New York with the Standards Committee of the American Institute of Electrical Engineers have resulted in the establishment of a thoroughly practical basis for the comparison of tenders for electrical machinery made

in the United States of America or Great Britain, the rules of both countries being now in agreement on all essentials.

Much also has been accomplished in one of the most difficult of tasks, the standardisation of small electric fittings with due regard to liberty in design. This work, in which again the masters' association has been most helpful, has occupied a great deal of time, and the difficulties and prejudices to be overcome have been great. Ordinary household wall plugs and sockets have at last been standardised as regards interchangeability. A specification to secure interchangeability between any charging plug and any socket of the type recommended by the Electric Vehicle Committee of the Incorporated Municipal Electrical Association, should be of material assistance in promoting the use of electric wagons and runabouts. A specification for electric supply meters has recently been evolved after much labour, and although some modifications may still be required, it is hoped that it may eventually prove satisfactory to both producer and purchaser alike.

A system of British standard graphical symbols for use in electrical engineering plans is being drawn up, and in this work the Committee has the co-operation of the American and Canadian Electrotechnical Committees.

The ramifications of the Committee are extremely widespread, and the commerce of the world being largely international, it is natural that the Committee should be forced to envisage co-operating internationally. The Sectional Electrical Committee, with a different chairman, is, *ipso facto*, the British Committee of the International Electrotechnical Commission, which has branch committees in 15 to 20 different countries.

The problem of the rating of electrical machinery is, possibly, more intricate than the standardisation of any simple pieces of mechanism, electrical or otherwise. The conductivity of the copper, the permeability of the iron, the mechanical strength of the materials, can be estimated with sufficient accuracy from the results of definite and easily carried out tests on samples. Owing to their inherent properties, the insulating materials employed at present come into an entirely different category. They are governed by no well-defined laws, as in the case of the copper and iron, their properties are variable and alter largely for very small changes in the conditions of manufacture as well as those under which they are employed in the completed machine. One of the important problems, therefore, is the settling of the limits which it is considered necessary to impose in order to ensure that the principal causes of destruction of the insulating materials, the heating combined with the time element, shall be kept well within safe limits.

A clear distinction exists also between an "international standard of quality" and an "international rating." The international acceptance of the former has already been brought about by the adoption, by the I.E.C. at its Berlin meeting in September, 1913, of certain limits of observable temperature applying to the materials in general use to-day. But these limits do not offer a means of comparing directly machines from various sources, since they would not necessarily have the same temperature rise. The fact, however, that American and British electrical engineers are at one on this point of immense commercial importance, will doubtless have a great influence on the electrical industry of the world.

Every effort must be made to ensure that the British standard specifications are readily available to foreign purchasers as well as to those in the British Empire. A few of the specifications have already been translated into French, and it is hoped that satisfactory arrangements may be made to translate them all into French as well as Spanish. In regard to Russian, the question is somewhat complicated, but in this case also the matter is being given the most careful consideration.

The work which has been effected by the Committee should very materially assist in keeping the trade of our great Colonial Empire in the hands of British manufacturers. As regards the immediate future, so pregnant with vital issues to our trade, both home and export, the influential position of the Engineering Standards Committee as the central body, with its unique expert knowledge of standardisation, holds vast potentialities for good to the industry.

Some Characteristic Curves of a Poulsen-Arc Generator.

By N. W. McLachlan, B.Sc. Eng., A.M.I.E.E.

(Section G. Abstract.)

With a carbon-copper arc burning in hydrogen, without a magnetic blast, having a condenser (the capacity not exceeding a certain limit) and a variable inductance shunted across its terminals, there is a certain inductance and, therefore, frequency, for which the shunt current is a maximum. The present investigation was undertaken to determine whether this condition is applicable in the case of a Poulsen-arc generator: (1) When energy is absorbed in the shunt circuit by a variable non-inductive resistance; (2) when the energy absorbed in the shunt circuit is as small as possible. In both these cases there is a loss in the Moscicki condensers, this being unavoidable, unless air condensers are used.

Frequencies between 1.3×10^5 and 8×10^5 cycles per sec. were employed, the range of frequency in any experiment depending on the magnitude of the capacity. The resistance used varied from 70 ohms to 6 ohms, and the capacity from 0.0009 mfd. to 0.009 mfd.

The current in the shunt circuit was analysed; for the various capacities tested the most prominent harmonic was the second, other harmonics being comparatively small. With a capacity of 0.00924 mfd. the R.M.S. values of the second and third harmonics were, respectively, 30 per cent. and 9 per cent. that of the fundamental when the frequency was 3×10^5 cycles per sec.

Full details of the experiments were given in the paper, and the author arrived at the following conclusions:—

1. With fixed capacity and frequency there is a certain resistance giving maximum power absorbed in the shunt circuit. There is also a certain resistance for which the efficiency of the arc is a maximum; but the resistance corresponding to maximum power is smaller than that corresponding to maximum efficiency.

2. With fixed capacity and fixed resistance in the shunt circuit there is a certain inductance, and therefore frequency, for which the power obtained from oscillations of fundamental frequency is a maximum.

3. With given resistance and frequency, the power obtainable in the shunt circuit (both total power and that due to oscillations of fundamental frequency) and the efficiency of the arc increase with the capacity; but with larger capacities (of the order of 0.00368 mfd. and upwards) the burning, especially with small inductances, is apt to be irregular and noisy—*i.e.*, when the ratio L/C is small.

4. When the power absorbed in the shunt circuit is very small, the capacity being fixed and not exceeding a certain limit, there is a certain inductance, and therefore frequency, for which the shunt current is a maximum. For capacities beyond a certain limit there does not appear to be any definite maximum value.

5. A diminution in the strength of the magnetic blast does not cause any appreciable alteration in the maximum power and maximum efficiency. The maximum power occurs at a lower frequency, and more power is obtainable at lower frequencies than with a stronger blast.

6. A diminution in the strength of the magnetic blast does not cause any appreciable alteration in the fundamental frequency of the oscillations in the shunt circuit; but there is a tendency for the second harmonic to increase with capacities of 0.00368 mfd. and upwards.

7. The most prominent harmonic in the shunt circuit is the second, thereby showing the existence of an asymmetrical current wave. This harmonic for any given capacity increases with decrease in inductance, and therefore increase in frequency. For a given frequency the second harmonic increases with the capacity.

8. The insertion of resistance in the shunt circuit causes the burning to be less regular than it is without resistance. The irregularity of the burning increases with increase in the resistance.

In order to ascertain whether the loss in the Moscicki condensers had any considerable effect on the power obtained in the shunt circuit, an air condenser was arranged to have the same capacity at high frequencies as one of the Moscicki condensers. It was found that the loss in the Moscicki condenser was sufficient to cause a diminution in the power expended in the shunt circuit in some cases exceeding 15 per cent.; but this did not invalidate any of the conclusions given above. The capacity of the Moscicki condenser at high frequencies was found to be 21.5 per cent. less than the capacity found by ballistic experiments.

Pressure Oil Film Lubrication.

By H. T. Newbigin, A.M.I.C.E.

(Section G. Abstract.)

Without lubrication a bearing will not run without excessive wear, and without artificial cooling no bearing with oil lubrication will run continuously if the temperature rises above 150 deg. F., because at about this temperature most oils begin to carbonise. The efficiency of a bearing must therefore be such that the temperature due to the heat generated by its friction, minus that dissipated by radiation and conduction, does not exceed this figure.

The action of a lubricant is twofold; it first of all alters the nature of the rubbing surfaces, thereby reducing friction (and this is the commonly accepted justification for its use), but under favourable conditions it goes much further than this and automatically generates a high-pressure oil film between the surfaces, entirely eliminating metallic contact and thereby enormously reducing the friction. This is what is now called "pressure oil film lubrication." It occurs to a limited extent in most journal bearings, but does not occur in ordinary collar thrust bearings.

The phenomenon of pressure oil film lubrication was first noticed by the late Mr. Beauchamp Tower. Following on Mr. Tower's experiments, the late Prof. Osborne Reynolds, F.R.S., showed that the friction under the circumstances was merely that due to the viscous flow of the oil. From the practical point of view the most important things that he showed were:—

First, that in order to obtain a pressure oil film between lubricated surfaces the surfaces must have a slight inclination

to each other, with the opening at which the oil enters greater than that at which it leaves. Or, in other words, that the oil film must be wedge-shaped.

Secondly, that in the case of a journal bearing the wedge form of the oil film occurs naturally, due to a slight shifting of the centre of the shaft in relation to the centre of the brass.

Thirdly, that such a wedge-shaped oil film cannot occur in a collar-thrust bearing; hence their inefficiency and low carrying capacity.

It was left to an Australian engineer and mathematician, Mr. A. G. M. Michell, of Melbourne, not only to complete Reynolds's theory, but also to show how its teaching can be applied in practice. On the assumption that the thickness of the oil film at the entering edge is twice as great as at the leaving edge, he showed how lines of equal pressure within the film can be plotted and how the centre of resultant pressure can be determined for plane rectangular surfaces of varying proportional cross dimensions. He also demonstrated practically that a rectangular block pivoted at its point of resultant pressure will automatically assume an angle to an opposing lubricated surface, depending on the speed of rubbing, viscosity of the oil and pressure. On this principle he founded his now well-known thrust bearing.

The result of Mr. Michell's work has been to enable lubricated thrust and journal bearings to be designed with the principles of oil film lubrication as a basis, in the same way as ball and roller bearings are designed with the ball or roller as a unit, and as distinguished from the mere application of oil to the primitive forms of these bearings. The essential feature of the Michell bearings is the subdivision of the stationary surface into a number of blocks or pads, each pivoted at its back, and so free to assume a slight angle with its contacting surface. Bearings designed on this principle differ radically from the primitive forms of journal and thrust bearings, but the results obtained in practice have fully justified the change.

Taking the case of the thrust bearing first, the Michell thrust bearing differs from the older type in having only one collar, the multiplicity of collars in the older type having been necessitated by the low carrying capacity of parallel rubbing surfaces, as distinguished from the high carrying capacity of those in which the fixed surface is subdivided and made free to assume the angle to the opposing collar necessary for the formation of oil pressure within the film.

The Michell thrust bearing has a coefficient of friction of about 0.0015 as against 0.03, and carries 200-300 lb. per sq. in. with a much greater factor of safety than the primitive form has at 50 lb.

The subdivision of the fixed surfaces into a number of segmental tipping blocks or pads is the essential feature of all thrust bearings made on this principle, but there are many variations in the design of the housing and method of carrying the tipping blocks, depending on the particular use to which the bearing is to be put.

In the case of the thrust bearings in steam turbines the blocks are symmetrically disposed around the faces of the collar, and each series is mounted on a ring partly spherical on one face, the convex surfaces of which are outward and rest on correspondingly spherical seats for the purpose of automatically distributing the load among the blocks. The blocks are mounted on the faces of the rings next the two sides of the collar against which they pivot, either along radial lines or on rounded pins.

This type is entirely enclosed, and is supplied with an oil circulation by means of an independent pump. The oil passes through an oil cooler on its course, thereby removing the heat generated by friction from the actual surface of its origin. The mean rubbing speed sometimes exceeds 100 ft. per sec. Slow-speed bearings are made on the same principle, with grease lubrication.

Upwards of 800 Michell thrust bearings are now running in this country alone, in sizes varying from 1 to 15 in. dia. of shaft, and larger sizes are in course of construction. The use of them is rapidly becoming standard practice in steam turbine work. The same principle is now being applied to journal bearings.

In lubricated journal bearings of the primitive type the phenomenon of pressure oil film lubrication is much less marked in the case of bearings of large diameters, probably owing to the greater oil clearance that is necessary in large sizes and to the extreme thinness of the oil film. For example, a journal bearing of 2 or 3 in. in diameter will run satisfactorily under a pressure of 300 to 400 lb. pressure per sq. in., but it is not found advisable to load large bearings above 100 lb., even with a forced oil circulation.

The pressure oil film only occurs along a narrow strip in the primitive type, and the remaining surface merely forms a brake on the rotation of the shaft, so that the designer is again restricted and can only reduce the pressure to the limit found safe in practice by increasing the length of the bearing. But by subdividing the circumferential surface into a number of segments, each of which is pivoted at its back, and thereby free to form an independent pressure oil film between its rubbing surface and the shaft, the number of the pressure oil films can be increased, so that the full projected surface of the bearing becomes effective for carrying load, and the brake surface is eliminated. The friction is thus reduced, the load carrying capacity increased, and the bearing shortened.

A series of tests has recently been run on a Michell journal bearing by Messrs. Cammell, Laird & Co., Ltd., Birkenhead. The bearing surface is divided into 12 segments, each of which is pivoted on a rib at its back, so that it is free to lift at its leading edge to allow the necessary wedge-shaped oil film to form. The faces of the segments or blocks are lined with white metal, each surface being 2 in. square, giving 48 sq. in. of rubbing surface, the equivalent projected area of each half of the bearing being 16½ sq. in.

In addition to the segments being free to tilt, the seat on which they rest is partly spherical, thereby making the bearing also a swivelling one. A circulation of oil was passed through the bearing; each run was continued until the oil temperature ceased to rise. The ingoing and outgoing temperatures of the oil were also recorded, together with the weight of the oil passing, and the R.P.M.

The following are the results observed, together with the friction calculated from the heat taken up by the oil. The friction is that for the two halves of the bearing pressed together. To get the coefficient of friction these figures require to be divided by twice the load.

Test of Experimental "Michell" Journal Bearing. May, 1916.

Duration of test.	Bearing pressure.	Revs. per min.	Surface speed.	Oil supply.		Friction H.P. from heat to oil.	Coefficient of friction.
				Rise of temp. F.	Flow of oil.		
Mins.	Lb. per sq. in.		Ft., min.	Deg.	Lb., min.		
105	145	620	1,950	20	14·8	2·8	0·0099
45	520	605	1,900	16	19·0	2·9	0·0029
30	900	620	1,950	25	22·7	5·4	0·0031
60	145	1,320	4,140	22	26·4	5·5	0·0091
60	520	1,303	4,100	35	33·0	10·9	0·0051
30	900	1,320	4,140	41	33·0	12·7	0·0034

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

To Go—or Not to Go?

Referring to the recent correspondence on station engineering as a profession, I am sure I do not agree with some of your correspondents' views. "East Coast" regards all electrical plant-running as child's play, his sole reason being that machinery is now so standardised and perfected automatically that any unskilled labourer can operate it. May I ask, has "East Coast" ever had anything to do with the operation of generating station or substation gear, especially some of the older systems? The reason I ask, is that I have usually found that the men who decry such work as "easy" and "unskilled," are the first to do damage when they do get the chance of operating a little on their own. I have in mind a very recent instance.

Again, another correspondent says he cannot expect to find much technical ability in a switchboard attendant—"a man who inspects his bearings every hour, and occasionally replaces a burnt-out lamp." No doubt, this gentleman is suffering from the same delusion as "North-East Coast," unless the switchboard he was on (if any) was one of those volt-pushing and "let-the-shift-engineer-do-it" affairs on which we find women feeling so proud of themselves. It is true we do find many of the so-called practical men about—men who close a switch because someone else told them it was right to do so; but let some of them be put in charge of a type of plant with which they are unfamiliar, and they will soon be all at sea.

Very true, there is, unfortunately, nothing much in station work as a permanent profession; but why run it down as useless, merely because it is no good financially? For my part, I admire the "young man who goes from job to job trying to pick up all he can." How can he get his experience otherwise?

My opinion is that a man who has had a few years about the stations has learned discipline, self-denial, patience, alertness, nerve and resourcefulness—not to mention many technical points other beginners might miss; and even if he has had to do with a meagre wage, he has a better electrical knowledge with which to get a good job than some of the other so-called electrical engineers and electricians.

D. F. B.

Linking-up Electricity Works.

In the memorandum published by the Joint Committee appointed by the I.M.E.A. and the I.A.E.P.C. to consider the question of the linking-up of electricity supply undertakings, Appendix B contains a diagram showing the average working day load curves of A, a power station having a maximum load of 3,000 kw., and B, a power station having a maximum load of 20,000 kw.

The curves showing the distribution of load after linking-up these works are not what would be obtained in actual practice; A

is shown as taking up 2,800 KW. at 1 p.m., and dropping this again at 9 p.m., and B as dropping this load at 1 p.m. (2,800 KW. sudden extra drop in the dinner-hour "valley"), and then on a rapidly falling curve doubling its load at 9 p.m.

In actual working A would pick up about 500 KW. at 1 p.m., and gradually work up to 2,800 KW. by 2 o'clock; this would materially assist B by making the after-dinner "load-climb" rise at an easy angle. In a large station this after-dinner climb is one of the most trying periods in the day's running. Then at 8 p.m. A would commence to regulate its supply off with the falling load until it could shut down at 9 p.m., the load on B remaining stationary between 8 p.m. and 9 p.m. instead of, as shown in diagram, falling from 7,000 to 3,000 KW., and rising again to 5,800 KW.

J. Y. M.

LEGAL.

P.O. Tube Railway and Compressed Air.

At the Surveyors' Institution, Westminster, on Monday, Mr. Alexander Ross, as Arbitrator, heard a case in which the parties were the Great Eastern Railway Co. and the Postmaster-General, which raised an important point as to the use of compressed air in a portion of a tube railway which will run under the hotel and part of the general offices at Liverpool Street Station, and which is being constructed from Paddington to Whitechapel, on behalf of the Post Office, for the carrying of mails. The Great Eastern Railway contended that compressed air was necessary as an additional safeguard. On behalf of the Postmaster-General, it was submitted that compressed air was quite unnecessary.

Mr. G. M. Freeman, K.C., appeared for the Great Eastern Railway, while Mr. A. F. Walter, K.C., and Mr. Rowland Burrows represented the Postmaster-General.

In opening, Mr. Freeman said the Railway Co. desired the use of compressed air as an additional safeguard by reason of the peculiar nature and character of the property concerned. It was peculiar because of its enormous public importance and its physical construction. Enormous pressures were brought to bear upon the supporting columns, and at one end the whole was carried on one continuous girder, so that if anything happened the consequences might be disastrous. Not only would there be tremendous pecuniary loss, but also great public inconvenience, and possibly danger.

The first witness was Mr. Basil Mott, who said that, in his opinion, this was exactly one of the cases where compressed air ought to be used. If a movement began in one of the pillars, it might be a very difficult matter to check.

In cross-examination, Mr. Mott, replying to a suggestion that the clay at the spot in question was extremely hard, and some of the finest clay to be found, said, in his opinion, it was exceedingly difficult for anybody looking at clay to say whether it was liable to give movement or not. The clay was not exceptionally good under Liverpool Street Station; in fact, he thought it was of a bad character, and he had used compressed air there himself. He had carried out tunnels in close proximity to Liverpool Street, and had had movement. Then he had put on compressed air and the movement had ceased. He had come into "pockets" in the London clay at a depth of 40 ft.

Mr. Horace Wilmer, chief engineer of the Great Eastern Railway, said the portion in regard to which the use of compressed air was desired was 462 ft.—about one-third of the whole interference with the company's property. The height of the hotel was about 100 ft. above rail level, and the height of the offices was about 95 ft. above rail level. If the tube did any damage the Postmaster-General was responsible, but in Witness's opinion this was a case in which the railway company ought not to be exposed to any sort of risk. No compensation would pay them for the driving away of passengers and general dislocation of business.

In cross-examination, the Witness said he understood that the Postmaster-General's view was to save a few thousands and damn the consequences. The buildings in question cost the railway company nearly half-a-million. At one point on the spot in question the weight was 4·3 tons to the sq. ft. The Central London Railway under Liverpool Street Station was carried out with compressed air.

Mr. C. L. Morgan, chief engineer of the London and Brighton Railway, said, in his view, the tube under the area in question should be constructed with compressed air. The total load of the buildings was 10,000 tons. It was well known that the work could be carried out much more safely with compressed air than without it. Blue clay gave as soon as the air got to it.

This was the case for the Great Eastern Railway.

On behalf of the Postmaster-General, Mr. Dalrymple Hay, the engineer of the work, said the railway at present had reached a point between Blomfield Street and New Broad Street—a distance of about 400 ft. from the southern face of the hotel. He produced samples of clay taken that morning on the Whitechapel side and the Finsbury side. Having had to do with some 45 to 46 miles of tube railways, he thought he could say these were very hard samples of clay. They were constructing tunnels varying from 7 ft. to 29 ft. diam. They had used compressed air on no part of the railway where the tunnels had been wholly in the London clay. They had used compressed air in the neighbourhood of Mount Pleasant, where the material was the worst he had ever seen—what was called redeposited clay. They had successfully gone under King Edward's Buildings, and the proposed work was child's play compared to this. In his view, compressed air would not serve any useful purpose.

In cross-examination by Mr. Freeman, Mr. Hay said a firm of contractors had estimated the cost of compressed air at £10,000 to £12,000. He did not see why the public should spend £12,000 when it was not necessary.

Evidence was also given on behalf of the Postmaster-General by Mr. J. D. Middleton, chairman and managing director of Messrs. Walter Scott & Middleton, contractors for public works, and Mr. Elliott Cooper, and, on the termination of the inquiry, the Arbitrator arranged to visit the station and the workings.

The Arbitrator will announce his decision in due course.

Workmen's Compensation Cases.

At the Westminster County Court, when a wireman sought compensation on the ground that he could not do his work, it was stated by Major Malcolm Nicholls, a consultant to St. Bartholomew's Hospital, that the man had only lost the ring finger of the left hand. He could certainly do work; indeed, men like him were needed for hospital work, and they could not be found. He could get him employment at once at from 30s. to 35s. per week. According to the *Daily Telegraph*, Major Nicholls said that he had seen men who had lost three fingers working well in hospital. "We cannot get the men, and, if we are to win the war, everybody must help. The loss of a finger will not prevent a man doing some work. Men have gone back to the Front after losing even two fingers or an eye."

In the Supreme Court (Appellate Division), Cape Town, on September 12th, judgment was given in a case in which the dependents of a workman named Schurmann claimed £500. Schurmann was an employé of the Victoria Falls and Transvaal Power Co., Ltd., and his death occurred while he was working in a live chamber at Rosherville power station, last April. The company repudiated liability, on the ground that the accident was attributable to deceased's own serious and wilful misconduct.

The Chief Justice, in a very lengthy judgment, came to the conclusion that the accident was attributable to the serious and wilful misconduct which had been brought home to the deceased. His injuries were sustained through his entering and working in the live chamber in contravention of the regulations. In giving judgment for the company, the Chief Justice said the company, having been vindicated, might well award suitable compensation; but he could not allow his strong sympathy for the dependents to lead him to strain the law in their favour.

Wheatstone-Morse Translating Machine.—Petition for Prolongation of Patent.

The petition of F. G. Creed, Wm. A. Coulson, and Creed, Bille and Co., Ltd., Telegraph Works, East Croydon, electrical engineers, the beneficial owners of a patent granted to Messrs. Creed and Coulson, was mentioned to Mr. Justice Sargant, in the Chancery Division, on Tuesday, on an application to fix Wednesday, November 1st, for the hearing of the petition. The invention for which the letters patent were granted consisted of "improvements in or relating to means or apparatus for operating or controlling type-writing and type-setting mechanism by means of perforating tape." The object of the invention was to reproduce telegraphic messages in ordinary readable printed characters, and the system of telegraphy to which the invention was applicable had long been known as the Wheatstone-Morse system. Mr. Austen Cartnell, for the Board of Trade, said the proposed date would suit all parties, and his Lordship acceded to the application.

WAR ITEMS.

Technical Instruction of Women Workers.—The Higher Education Committee for Wimbledon and District has decided to utilise its new engineering department at the Technical Institute solely for the instruction of women for munitions work.—*Times.*

Employment of Women in Electricity Works.—The Marylebone Electricity Committee reports that for some time past it has engaged women to carry out the following duties:—Junior engine drivers, volt regulators, storekeepers, clerks, lamplighters, meter testers, prepayment meter collectors, and maintenance attendants.

Tramways as Certified Undertakings.—The Ministry of Munitions has placed the Colchester Corporation tramway undertaking under the head of certified undertakings.

The Ministry has also issued a certificate that the supply of tramway facilities by the L.C.C. tramway department is of importance for the purpose of carrying on munitions work. The effect of such a certificate is that the undertaking will be subject to the provisions of Part I of the Munitions of War Act, 1915, which prohibits strikes and lock-outs, and the provisions as to leaving certificates will apply to employés in the tramway department. Under Section 4 of the Munitions of War Act, 1915, the Minister of Munitions may declare certified undertakings to be controlled establishments. The Minister has stated, however, that, as at present advised, he does not propose to take this course in the case of the Council's tramways.

Ministry of Munitions.—It is announced that as a consequence of the new arrangements in the Employment Department of the Board of Trade, the following appointments have been made by the Minister of Munitions: Mr. Stephenson Kent to be Director-General of Munitions Labour Supply; Mr. U. Wolff to be Deputy Assistant General Secretary to the Ministry.

Australian Metal Industry: Enemy Influence. — The *Sydney Morning Herald* states that in order to prevent the efforts of the Ministry in regard to enemy control of the Commonwealth's output of metals being rendered nugatory by the insidious devices of the enemy's agents, Mr. Hughes submitted, at a special meeting of the Federal Executive Council, in August, the following regulations under the War Precautions Act:—

"That no contract or agreement for the sale of any mining or metallurgical company or business, or any share or interest in any mining or metallurgical company or business, to any person other than a natural-born British subject, residing or carrying on business in some part of the British Dominions, or to any person on behalf of any person other than such British subject, shall be entered into unless the consent in writing of the Attorney-General has first been obtained."

A company will be required to refuse to register the transfer of a share or interest in any such company unless it is satisfied that the provisions of these regulations have been complied with.

Army Light and Power Work.—The Army Council has made the following Order:—

The provisions of Section 7 of the Munitions of War Act, 1915, as amended by Section 5 of the Munitions of War (Amendment) Act, 1916 (which relate to the prohibition of the employment of persons who have left munitions work), shall apply:

1 To any establishment, being a barracks or hutted camp, so far as concerns the construction, alteration, or repair thereof, or the supply of light, heat, water, or power for the purpose of such construction, alteration, repair, or supply.

2. To any establishment the work of which consists in whole or in part of such construction, alteration, repair, or supply, as aforesaid.

In any case in which any such work is executed under the direction of the Royal Engineers or the Director of Barrack Construction.

The following Certificate has also been issued:—

Whereas, in pursuance of S. 20 of the Munitions of War (Amendment) Act, 1916, the Minister of Munitions has made arrangements with the Army Council for the exercise by the Army Council of the power of the Minister to certify the supply of light, heat, water, or power to be of importance for the construction, alteration, or repair of any barracks or hutted camp, now, therefore, the Army Council, in exercise of the power so delegated to them, certify that the supply of light, heat, water, and power is of importance for the construction, alteration, or repair of barracks or hutted camps in all cases in which such light, heat, water, or power is supplied for the purpose of such construction, alteration, or repair as aforesaid.

Property and Trade Protection After the War.—With a view to securing united action among property owners and traders for the protection of their interests after the war, a meeting, under the auspices of the Council of the Liberty and Property Defence League, was recently held at the League Offices, 25, Victoria Street, Westminster, Sir Richard Temple, Bart., in the chair. A committee for the purpose of drafting a scheme of procedure and organisation was appointed, and it was resolved that the scheme should provide for the formation in every borough in England, Wales, and Scotland of a local Joint Standing Committee representing property owners, traders, and manufacturers for the purpose of taking action (1) with respect to attempts that may be made to resume the unnecessary, extravagant, and wasteful pre-war activities of governmental and municipal bodies, (2) with respect to proposals for town planning, housing, and other "social reforms" at the public expense, the adoption of which would necessitate the expenditure of enormous sums of money, (3) to ensure that all restrictive war-emergency legislation affecting trade and industry shall cease at the termination of the war, and that the business of private citizens be left free to resume its normal course.

Exports to China.—The "London Gazette" for October 17th contains a further list of names of persons, &c., to whom exports for China and Siam may be consigned.

Herr Rathenau's Department.—In its most interesting column, "Through German Eyes," the *Times* contains the following reference to Rathenau's raw materials department:—Herr Emil Ludwig contributes to the *Zukunft* a remarkable article on the work of Herr Rathenau, who seems to have retired some time ago from the control of the Raw Materials Department of the Prussian War Office. The article is obviously a controversial glorification of the Jewish industrialist at the expense of the ordinary Prussian bureaucrats, but it contains interesting statements about the original organisation. It is stated that Herr Rathenau was called in by the War Office on August 8th, 1914, and on the following day General von Falkenhayn, who was then Minister of War, gave him plenary powers. He was sworn in as an official, and allowed to form the "Raw Materials Department," with the assistance of a major. The department began with five officials. There are now 600, "working in houses which fill a street front," and the department is the largest in any Prussian Ministry. Rathenau had difficulty in obtaining adequate assistance, and was strongly opposed by permanent officials, professors, and Reichstag deputies. Rathenau's first business was to form an estimate of available supplies, and he is said to have reached the conclusion that in the most important cases the supply would not meet the demands of the Army for more than a year. The organisation at first dealt with only six classes of materials, but now deals with over 100. Rathenau set himself to obtain control of all available raw materials, to stop all unnecessary production, to concentrate in Germany everything that could be bought abroad or confiscated in occupied territory, to promote new methods of production in Germany, and, wherever possible, to invent substitutes. In face of great opposition Rathenau avoided simple confiscation of metals and other raw materials, and established the principle that the Government should merely prevent the supply from being used for other than military purposes. It is claimed that the "conversion of German industry" was completed in two months, and that in eight months Rathenau reported to General von Falkenhayn: "The war is now independent of the provision of raw material. Everything is being provided to the extent that is necessary. Nothing now crosses our frontiers except what is hurled across them by our guns. Lloyd George's scheme, the blockade, has become ineffective."

After-the-War Trade.—In one of the committee rooms of the House of Commons, on Thursday evening last week, nearly 100 manufacturers and employers of Tottenham and neighbourhood attended, with the approval of the Board of Trade, a conference for the purpose of considering the question of British trade after the war. No fewer than 32 different trades were represented, the following electrical engineers being present: Mr. A. E. Wheeler (the Acme Electrical Co., Ltd.), Mr. P. Abraham (the Sunlight Manufacturing Co., Ltd.), Mr. C. H. Smith (Messrs. Belling & Co.). Kindred interests, such as engineering and lamp manufacturing, were also largely represented. This was the first gathering of the kind held in this country, the precise object being to organise the manufacturing resources so that Great Britain would be prepared to compete successfully with other countries after the declaration of peace, in capturing the extensive trade formerly carried on by Germany. The conference was regarded with considerable importance, and no doubt other centres of industry will follow Tottenham's lead. The chair was taken by Mr. A. E. Broadberry, engineer and manager to the Tottenham and District Light, Heat & Power Co. Mr. Percy Alden, M.P., and Mr. J. R. Pretyman Newman, M.P., local Members of Parliament, gave addresses, and a sub-committee was appointed to submit a scheme for the formation of a Tottenham and district trade organisation. It is anticipated that when the post-war boom in trade comes along Tottenham will be prepared to take its full share.

Exemption Applications.—At the Godalming Tribunal, G. H. Avern (40), a meter inspector, was applied for by the Urban Electric Supply Co. He had been passed for C 2, and since making the application had passed his 41st birthday. Six months' exemption was given.

At Hebden Bridge, W. A. Harwood, single, an electrical engineer, applied for exemption on the ground that there was not another man within 16 miles engaged in the repair and maintenance of electrical machinery. He was short of men, and had to work as hard as any of his men to try to cope with the situation. He was put under "certified occupations."

Cranbrook (Kent) Tribunal has refused exemption to Lewis Hopperton (25), electric light attendant at Sissinghurst.

Sheffield Tribunal granted exemption until October 31st to Mr. B. Hudson (33), electrical engineer, who appealed on the ground of serious hardship.

Before the West Kent Appeal Court, Mr. E. W. Sells (33), chief engineer for Messrs. Oswald Jones & Co., electrical engineers, Maidstone, was appealed for as being indispensable. The Hon. H. A. Hannen, chairman of the West Kent Hospital, wrote stating that Mr. Sells's services at the hospital with the X-ray installation were of greater value than his services would be in the Army. Several firms testified as to the value of his work, and Mr. Jones said that he did not believe that another firm in the town had an electrician who could do the skilled medical work which Mr. Sells did. It transpired that Mr. Jones himself was qualified to do the work, and that Mr. Sells was paid £1 15s. per week, with free premises, &c., equalling £2 5s. per week. The Military representative observed that in the dockyards no electrician was paid less than £2 6s. per week. A month only was allowed.

At Berwick-on-Tweed, Mr. J. Shanks, Fenwick, electrician on the Haggerston estate, was appealed for by the land agent, who said that he could not be replaced, and that the Castle was now occupied by 50 convalescent soldiers, none of whom could undertake the work. The appeal was rejected.

On the appeal of the Electric Traction Co., Peterborough Tribunal have granted three months' conditional exemption to E. A. Sewter (30), electric car fitter and turner.

Before the Totnes Rural Tribunal, an electrician (32), engaged on an estate at Haberton, was applied for as absolutely indispensable. He was rejected in December, 1915, and is now passed for foreign garrison duty. Exemption was allowed until January 1st.

Cuckfield Rural Tribunal has refused exemption to a Lindfield electrician and fitter, appealed for by the electric light company. The manager said that the pre-war staff numbered 44; now he had 17, and 33 of the staff had enlisted. The man appealed for was indispensable, being in charge of the overhead cables.

A Nutley (Sussex) electrical engineer who appealed on medical grounds, said he suffered from a very weak heart, but

had been passed for labour abroad. He was directed to go before the Medical Board in London.

Exemption given to a lighting fitter at Lydbrook Electric Cable Works was appealed against by the Military at the Gloucestershire Appeal Court. It was stated that the company employed 250 persons, including 175 women, and were engaged making field telephone wires. The cable made was for important purposes, and the man appealed against had been at the works for eight years, and was well skilled in all branches of the manufacturing work. If he was taken the night shift would be stopped, and this would considerably delay the output of the heavy cable so urgently needed. The Chairman (Mr. F. A. Hyett) said he thought the case was one where the Military should supply a suitable substitute, and time would be allowed for this to be done.

Eastbourne Tribunal has given conditional exemption to two leading stokers at the Corporation electricity works, and eight weeks' exemption to the personal assistant to the electrical engineer (Mr. J. K. Brydges), the latter being advised in the meantime to obtain a lady assistant.

The Clerk to the Aldershot U.D.C. appealed, on October 3rd, for the retention of Mr. S. Alder (34), engineer in charge of the electric power station at the sewage works, passed in Class B 1 after rejection on attestation. It was stated that he was an expert engineer and fitter, and was in charge of the electric pumping plant, &c. The station was working day and night, and it was essential that Mr. Alder should be retained in the interests of public health. Two months were conceded.

At Aldershot, on October 3rd, the Aldershot and District Traction Co. appealed for two drivers, who were ordered to be called up in a month; another driver, appeal dismissed; two other drivers, put back for medical examinations; a foreman coachbuilder, given three months; a driver, given a final month; and two other employés, who were refused time.

An electrician (33), in business at East Street, Prittlewell, appealing for further exemption, stated that his partner and six men had joined up. He himself had very bad health, and for 10 or 12 years had been strictly dieted. Col. Newitt said that garrison duty abroad would just suit the applicant. The Tribunal gave until January 1st, with a further medical examination before that date.

At Hastings, further exemption was sought by Mr. R. H. Pattenden (36), electrical engineer. A firm for whom appellant does all their electrical work supported the claim. Appelland, who is passed for garrison duty abroad, was given conditional exemption, without time limit, on joining the Volunteers.

At Southend-on-Sea, the Corporation applied for exemption for a tramcar driver (30), who had been on the staff for nine years, and an inspector (33), with 11 years' service. Both were exempted as being in certified occupations, and ordered to drill twice weekly.

Ilfracombe Tribunal have given certificates of conditional exemption to Mr. H. J. Stewart (33), resident engineer and manager of the Electric Light & Power Co., and A. J. Rudd, a member of the staff, both being held to be in certified occupations.

At a sitting of the Broadstairs Tribunal, on October 10th, the Isle of Thanet Electric Tramways and Lighting Co., Ltd., applied for 15 employés, the manager and secretary, Mr. Forde, stating that before the war there were 270 employés, and now, with females and boys, there were only 119. Those applied for were two inspectors and drivers, a storekeeper, a steam-engine driver, seven drivers, and four men in charge of sub-stations. Asked if women could not act as drivers, Mr. Forde said he believed the Board of Trade would not sanction such a proposal for their system. If the Military could provide substitutes he would withdraw the appeal. Four drivers were given conditional exemption, one three months, and the other two were refused; the inspectors were conditionally exempted; the storekeeper was allowed six months, one substation man was conditionally exempted, and the other three allowed three months each; and conditional exemption was conceded to the steam-engine driver.

At Oxford, Messrs. W. Lucy & Co., manufacturing electrical engineers, appealed for David G. French (19), brass fitter and finisher. The case had been put back for a badge to be applied for, and the firm's manager (Mr. Magin) said that the Ministry of Munitions had badged the man. Captain Fox remarked that the Tribunal would find that French would be called up, although badged. The Town Clerk explained that men for munitions were equally as important as men for the Army, and the badge was dated September 12th. Mr. Magin pointed out that French was only passed for home labour. The Tribunal decided that they had no jurisdiction in the case.

The Lancashire Electric Power Co. appealed, at Swinton, for the retention of an overhead linesman, aged 21. The company's representative said that 11 out of 13 overhead linesmen had enlisted, and if any more were taken he did not know what they would do. Exemption was refused.

An electrical engineer, aged 38, appealing at Eastbourne, said that his only assistant was a boy of 13. His solicitor mentioned that at Enfield six months were given to the owners of one-man businesses, but the Chairman said that they were not bound by what other Tribunals did. Appellant was given until December 31st, with no further appeal without leave.

At Reigate, exemption was claimed for Chas. Morgan (29), shift engineer at the Corporation electricity works. Mr. W. S. Ross, electrical engineer, said they now had only three shift engineers, and they had not had a single reply to advertisements for a man to take the place of Morgan. Temporary exemption until January 1st was granted.

At the Atherton (Lancs.) Tribunal, a mill electrician was granted temporary exemption on condition that he joined the local V.T.C. He explained that he was working late each night and could not attend drills very regularly. He was instructed to attend at least once a week.

At Dewsbury, on Oct. 11th, an electrical engineer, whose partner is in the Flying Corps, was given conditional exemption.

At Sheffield, on Monday, exemption until March 31st was granted to H. J. Burdett (40), electrical engineer, appealed for by Messrs. W. Johnson & Co.

At Bath, on Monday, A. C. Brackstone (39), electric fitter with Messrs. R. Kendall & Sons, passed for C 3, was conditionally exempted subject to his joining the Volunteers.

The Aysgarth (Yorks.) Tribunal granted conditional exemption to the manager of the electrical generating station at the Hawes Wensleydale Dairy so long as he remains in his present occupation.

BUSINESS NOTES.

The Australian Market.—The electrical position of affairs in Australia, as it appears to American eyes, is explained in the following extracts from a recent report by U.S. Consul W. C. Magelssen, at Melbourne :—

"While the motor field presents the most apparent attractions at the present time, it is also typical of other industrial lines. Victoria is now in process of electrifying her metropolitan railway system, is considering, in common with the other States, a scheme for the bulk handling of grain on the State-owned railways, and is rapidly developing a system of electric tramways in all the suburban areas of Melbourne, and the principal country towns. In addition, electrical machinery and equipment are required for the lighting of provincial towns, and contracts are pending for the extension of irrigation works, the locking of the river Murray, Australia's longest river, which is the boundary between Victoria and New South Wales, and water conservation works in various parts of the country, requiring concrete-making machinery and steel rods for the construction of dams and conduits.

"Although the whole value of the Commonwealth's imports from Germany in the year before the war did not greatly exceed $34,065,500, great inconvenience has been caused by the cessation of imports from Germany. The chief trouble has been experienced in the electrical and engineering trade. Lately steel production was begun at Newcastle, New South Wales, where the Broken Hill Mining Co. has established modern smelting works, getting the necessary ore largely from the Iron Knob, near the headwaters of Spencer's Gulf in South Australia; but prior to the war the whole output of this concern was practically bespoken for various railroad extensions under the States' Governments, and for the great trans-Continental line now being constructed by the Commonwealth Government through the States of South and Western Australia, to link up the two sides of the continent.

"This leaves Victoria once more dependent on the outside world for supplies of railroad and constructional steel, and for all classes of machinery, implements, tools of trade, &c., except such as are manufactured in Melbourne from imported metal. In the manufacture of electrical goods the State had not made much progress before the war began, and great dependence was placed on German firms to keep the workshops supplied with the goods necessary for the extension and maintenance of electrical plants of all kinds.

"The railroad electrification scheme, which is expected to cost approximately $29,199,000 complete, has been mainly entrusted to British engineers to execute, but the war work in England has left them in no better position as to supplies than it has left others, and, as a result, the enterprise has been retarded, and there is at time of writing no definite conception as to when it may be finished. Lack of material is the reason for the delays. Bent on a policy of economy, the Government has taken the opportunity to stop temporarily some of the regrading and other work associated with the electrification scheme, but inability to get supplies is the root cause of the reduction of energy in this important public enterprise. Since the energies of Europe are concentrated upon the war, and will be afterwards directed upon the rebuilding of shattered towns and industries, the Victorian electrification scheme is likely to drag, unless the required equipment can be brought from America.

"As all public services in Victoria are in the hands of the Government or the Municipal Councils, the initiation of new works rests with them, and not with private corporations. A notable exception existed in the Melbourne Tramway Co., which has now come to the end of its 30 years' lease of the central metropolitan roads. . . . Its system of cable cars, now out of date, radiates from the centre of the city to all the suburbs. The lease is falling into the hands of a public trust, which will carry it on as at present until the war is over, and then adopt electric traction. Linking the outer suburbs is a ring of municipally-owned electric trams, and these will be joined with the central cable tracks, and the whole will be controlled by the Public Trust.

"The municipalities from whom the roads were originally chartered will be strongly represented on the trust, and on their credit it is expected the future funds will be raised for the electrification of the central system and the extension of the outer suburban routes already operated by electric power.

"In other directions municipal control is now being strengthened. With a population of 650,000 inhabitants, Melbourne is divided under the control of 24 Councils, but the central City Council is now proceeding to absorb the inner suburbs piecemeal. Controlling the greater part of the tram lines, and having its own electric plant, the central body has the power of large expenditure on municipal services. No important contracts are offering at present, but works in view will entail importation of electrical and tramway equipment."

British Manufacturers and Australian Tariffs on Electrical Goods.—A deputation from the Australian Association of British Manufacturers and their representatives waited upon the Minister of Customs at Melbourne in August respecting tariff matters. According to the *Melbourne Age*, Mr. M. C. Coates, president of the Association, submitted a number of requests and suggestions for increased preference to Britain. On electrical goods he asked for an all-round preference of at least 10 per cent., and suggested that all foreign invoices should be loaded 25 per cent. for duty purposes, and then preference of 10 per cent. given on British goods. With regard to metal-filament lamps, he suggested that the duty should be based on watts, high-wattage lamps to be counted as two, three or more lamps, according to power. The present preference of 10 per cent. on lampware, brass tubing and gas mantles, and 5 per cent. on electric globes, brassware and oil engines, was considered insufficient.

Mr. J. K. Merritt, M.L.C., said it was necessary, after winning the war, that an effort should be made to build up the trade and industries of the Empire. Whilst British manufacturers were engaged in making munitions, the Americans and Japanese were capturing the markets. They were not to be blamed, of course, but their activity was creating greater difficulties for the future from the British manufacturing standpoint. American manufacturers were dumping goods in Australia at cheaper rates than those prevailing for the same articles in America.

The Minister, in reply, said that the first duty of the Government and the Parliament was to see that Australian industries were effectively protected. Although the first duty of the Government was to watch over Australian duties, it would not lose sight of its second duty towards the Empire. As a result of the war the Empire had been drawn much closer together, and the need for Imperial preference would not be lost sight. Regarding the need of blocking enemy goods, his experience was that it was almost impossible to sell enemy goods at the present time. Enemy goods condemned by the Prize Court had come into possession of the Customs Department, and they had to be sold in accordance with the Act, but he was afraid that they would realise a very poor price. People would not buy goods when they knew that they were of enemy origin.

National Insurance Act.—Correction.—In the article by Mr. J. J. H. Stansfield, which appeared on p. 369 of our issue of October 6th, No. 1,785 decision should have appeared in the preceding section dealing with classes of employment for which contributions *are* payable.

Catalogues and Lists.—The Paterson Engineering Co., Ltd., Windsor House, Kingsway, London, W.C.—1916 edition of the Paterson Red Book on water purification for industrial purposes. The book deals with the following matters: Sources of water supply: rapid filtration; water softening; and oil elimination. An abridged list of users is given. Some excellent pictures in half-tone and in colour show the Paterson filters, softeners, &c. The Government has requisitioned the company's premises, India House, Kingsway. Its temporary address is, therefore, Windsor House, as above. Copies of the catalogue can be obtained by all interested in these appliances.

International Time Recording Co., Ltd., 57, City Road, London, E.C.—Folder pamphlet, giving illustrated particulars and prices of their various models of time recorders.

British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park.—Instruction Book No. 5,390 (62 pages), relating to the installation and operation of the British Westinghouse rotary converters.

Dissolutions and Liquidations.—Resisto Electrical Manufacturing Co., Ltd.—This company is winding up voluntarily, with Mr. De Westley Layton, 167, Fenchurch Street, E.C., as liquidator. A meeting of creditors is called for October 20th.

Derby Electrical Co., Ltd.—A meeting is to be held at the offices, Woods Lane, Derby, on November 18th, to hear an account of the winding up from Mr. J. Perry Jones, the liquidator.

Chas. H. Blume (an enemy subject).—Creditors of this business must send particulars of their claims to the controller, Mr. J. W. Barrett, 19A, Coleman Street, E.C., by November 16th certain.

Charles Cooper, plumbers and electrical engineers, 2, King Street, Stratford, Manchester.—Messrs. H. & P. Cooper have dissolved partnership. Mr. H. Cooper attends to debts, &c.

Switchgear Construction Co., Ltd.—Creditors must send particulars of their claims, &c., to the controller, Mr. J. H. Stephens, 6, Clement's Lane, Lombard Street, E.C., by November 15th.

Trade Announcements.—Messrs. James Scott, Ltd., electrical and mechanical engineers, of Bootle, have opened branches at 317, Victoria Dock Road, London, E., and 27, West Bute Street, Cardiff, under the management of their Mr. E. J. Rimmer and Mr. T. W. Plunkett respectively, who have had lengthy experience in electrical work aboard ships. The firm will keep a large stock of electrical ships' requirements.

Mr. L. Darley, of Messrs. Hopkins & Darley, electrical engineers, St. Alban's Road, Watford, having left for military service, announces that the business will be continued under the management of his wife.

LIGHTING AND POWER NOTES.

Australia.—The Queensland Government has approved of an irrigation scheme for Inkerman, near Bowen, at a cost of £131,000. The estimates for the scheme are:—Preliminary work, £16,500; lifting appliances, £30,000; power station, £39,800; distributing network, £38,400.

Tumut (N.S.W.) has decided to install an electric supply plant.—*Commonwealth Engineer.*

The Albury electric lighting scheme, designed by Mr. W. Corin, chief engineer of the N.S.W. Public Works Department, is nearly completed. Electricity will be generated at 3,000 volts, three-phase, and stepped down to supply a 415-240-volt, four-wire distribution system. The distributing cables total about 80 miles, and are of aluminium, and street lights will be controlled by automatic time-switches. The original estimate of cost of the scheme was £11,000, but, owing to war conditions, it is estimated that the cost will be about £20,000.

Barnsley.—In connection with the proposed supply of electricity to houses in Mount Vernon Road, the Electricity and Lighting Committee has recommended that negotiations be opened with the Electrical Distribution of Yorkshire, Ltd., for its sanction to the issue of a Fringe Order under Section 6 of the Electric Lighting Act, 1909, or alternatively for the supply of electricity in bulk at the borough boundary on suitable terms.

Birmingham.—Cooling Tower Plant.—The Electricity Supply Committee reports that it has not been found possible to place the cooling towers for the Nechells temporary generating station on the site originally proposed, and they are to be erected on a portion of the land intended for the permanent station. The total extra cost is estimated at:—(*a*) Cooling pond and tower foundations, extra, £150; (*b*) alterations to railway sidings, £550; (*c*) pipe line, valves and supports, including supporting bridge across the River Rea, £6,830. The Committee recommends that the alteration be approved, and that application be made to the L.G.B. for sanction to the necessary loan.

Bradford.—Progress Report.—In a report on the work of the electricity undertaking during the municipal year ending this month, the Electricity Committee mentions that the total output for the year was 33,905,136 units, an increase of 5,161,418 units on the preceding 12 months, being the highest increase so far recorded. Bulk supply accounted for 3,157,521 units and motive power and heating 1,887,661 units of this increase. Private and public lighting and night supply to the tramways fell off, but these decreases were practically counterbalanced by additional day supply to the tramways. The income for the period was £167,177, an increase of £19,438; but, due to increased expenditure and additional capital charges, the net profit was £15,988, or some £3,000 less than in the previous year. Out of this, £7,500 was placed to rate relief, the remainder being applied to depreciation. Early this year it was considered necessary to extend the steam and electrical plant at Valley Road, at a cost of, roughly, £50,000 in each case; only the extension to the boiler and cooling plant was approved, and a subsequent application for sanction to the raising of £100,000 for additional generating plant and transmission extensions were also refused by the L.G.B. During the year a 5,000-kw. turbo-alternator has been put to work, also two 1,500-kw. rotary converters, while an older rotary has been replaced by a modern 1,500-kw. set.

The boiler house and cooling tower extension is progressing, and although it will not be complete for three months, it is hoped to use one boiler during the coming heavy-load periods. The Thornbury sub-station has been extended in connection with the supply to the Yorkshire Power Co.

In order to relieve the congestion at the works caused by horsed vehicles delivering coal, the coal in some weeks amounting to 50 per cent. above that required in the corresponding period last year, two 5-ton electric tipping wagons are being procured; for ash disposal a 3½-ton electric tipping wagon is also in use. Ten additional transformer chambers have been equipped, making a total of 45; 65 transformers of 10,909 k.v.a. are in use in them. A total of 67 miles of underground and 3 miles of overhead E.H.T. transmission is in use. Seven new bulk agreements and three renewed agreements represent a total of 6,851 kw., mostly new business obtained; the half-year to September 30th showed an increase of 5,000,000 units sold on the corresponding period of 1915, being equal to the increase of the whole of the previous year, and it is anticipated that the rate of increase will be maintained.

Bury.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £600 for the cable required to give a supply of current to a local works.

Canada.—The fifth annual report on the working of the Toronto hydro-electric system (for the year 1915) shows a gross income of $1,620,187, while working expenses amounted to $979,208,

leaving a gross surplus of $640,978; deducting interest and sinking fund and depreciation payments amounting to $624,067, and sundry other charges amounting to $13,773, there remained a balance for the year of $3,137. The surplus shows a large reduction compared with 1914, which is accounted for by the considerable reduction in the scale of charges which took place in January, 1915, under the advice of the Ontario Hydro-electric Power Commission, from whom energy is purchased in bulk. The consumers numbered 38,834, as against 31,500 in 1914; the meters in use were 39,284, as against 33,976; the street lanterns numbered 43,411, as compared with 40,596.

During the year, 109,501,961 units were sold, as compared with 82,927,015 units during 1914, the connected load amounting to 111,413 H.P. and the peak load to 40,180 H.P. The average price obtained for KW.-hours sold for the year shows a reduction of over 17 per cent. During the year, two sub-stations have been constructed, one of them having a branch store attached where accounts can be paid and the latest appliances can be obtained. New mains have been laid, bisecting the existing ring mains from which the whole supply in the city radiates. Half-watt public lighting has been introduced into Toronto Street and part of Richmond Street; this type of lighting was offered to the city in 1915, but the alternative—a reduction of the rate with the old type of lighting—was accepted by the Council. Roughly, the output sold has increased by an average of 25 million units a year for the last four years.

The report contains a declaration by the Commissioners of their financial policy, which is interesting; the Commissioners set aside each year, (1) interest on debentures; (2) sinking fund sufficient to pay off debentures at maturity; (3) depreciation—such sum as will amount at the end of the lifetime of the plant of an amount sufficient to replace same. This indication of policy is, it is stated, made because a proposal by the Finance Commissioners of the city, in future to issue debentures limited in term to the life of the asset for the purchase of which they are issued, has led to an impression that a depreciation fund can therefore be dispensed with. The Commissioners regard their allocation to depreciation as an obligation of sound policy and finance, designed, *inter alia*, to prevent the accumulation of city indebtedness for hydro-electric construction to such a level as might injuriously affect the credit of the city.

This view of the matter is not exactly that held in this country, where the same subject was discussed at great length some years ago, and it was for the most part agreed that posterity could fairly be allowed to undertake its own financial obligations, especially if a prosperous business were handed over to it.

Chesterfield.—The L.G.B. has intimated that it is prepared to sanction the borrowing of £20,600 for the extensions at the electricity works, when certain particulars have been furnished regarding the proposed turbine plant, and the work being put in hand at once.

Continental.—Norway.—The Christiania municipal electricity installation completed the twenty-fifth year of its existence in August. The city draws its electric supply from four waterfalls, which it has successively acquired and partly developed, the aggregate output of which is reckoned at 59,200 KW. delivered in the city. The progress of the undertaking has been steadily upward, the first year's actual working (1893) showing current delivered to 9,930 glow lamps and 21 motors, compares with, to-day, 470,861 glow lamps, 1,965 arc lamps and 5,140 motors of private consumers, and 628 glow lamps and 217 arc lamps for public lighting. Receipts in 1893 totalled 160,000 kroner, and working surplus 42,000 kroner, against 3,750,000 kroner, and a working surplus of 1,340,000 kroner at last account. Lately an agreement has been come to with the Government for the joint development of the municipality's waterfall of Solbergfos and the State's waterfall of Morkefos, the chairman of the Committee being electrical engineer Thorne, one of the municipality's representatives.

A hydro-electric station is under construction at the Mesna Falls, near Lillehammer, to supply an additional 1,000 H.P. to the cartridge and powder factory situated at the Raufos. The contributory communes of Gjovik, Faaberg, &c., are to be supplied from the same source.

It is stated that a Franco-American syndicate is arranging to establish a large electrotechnical establishment in Telemarken. The water power required will be at least 100,000 H.P. It was at first intended to acquire a site in Swedish Norrland, but the unfavourable political situation in the Gulf of Bothnia disposed of the idea.

The municipal authorities of Stavanger have decided to obtain a loan of 6,000,000 kroner for the electric development of the waterfall of Dargefos.

Spain.—La Sociedad Electrica de Mora la Nueva is the name of a new company which has lately been formed to establish a small central electric lighting station in the town of Mora la Nueva, in the Province of Sarragossa.

A concession has recently been granted for the establishment of a plant to utilise the water power of the Rivers Lobaras and Landro in the generation of electrical energy for lighting and power purposes in the Ferreira district of the Province of Lugo.

The Sociedad Minera y Metalurgica de Penarroya intends to establish two generating stations, one at Puertoblano of 20,000-H.P. capacity, and the other at Belmez of 12,000 H.P., using low-grade coal as fuel. The equipment will be that of the old Sociedad de Gasification Industrial, now defunct. The current generated will be partly utilised for the Society's own railways, and partly sold to other industries.—*Industria e Invenciones.*

Italy.—La Società Consorzio per Elettrotrazione is the name of a new undertaking which has recently been organised in Milan with a capital of £60,000, to develop projects for the establishment of electric power stations in the country, more especially in connection with the supply of power for railway operation.

Ealing.—Daylight Saving.—A decrease in sales of energy by the electricity undertaking of 22·4 per cent. is traced to the operation of the Daylight Saving Act.

Hereford.—Plant Extensions.—The T.C. has been authorised to carry out extensions estimated to cost £2,310 for buildings, £1,700 for a railway siding, £16,307 for machinery, switchgear, &c., and £3,213 for mains, for the electricity undertaking; as this is £5,530 in excess of the sum applied for last June, the L.G.B. is to be asked to sanction the surplus.

Horsham.—Offers are to be invited for the maintenance of the storage battery at the electricity works for a further period of 10 years from the expiration of the existing contracts with the Tudor Accumulator Co.

Liverpool.—Proposed Extensions.—The question of enlarging the city generating station will shortly be considered by the City Council.

London.—Bethnal Green.—The B. of G. has received a report from the chief engineer on the possibility of running the laundry plant (at present hand-operated) by electric power or gas, owing to the shortage of labour. He estimates the cost of motor-driven plant at £200 and of gas-driven plant at £227, and an annual saving on the working of £85 if electricity was adopted as a motive power and £41 if gas was used, as compared with the costs at the present time.

The Committee recommends that subject to the sanction of the L.G.B., steps be taken to run the plant by electricity.

Marylebone.—The general manager's report on the working of the electricity department for the June quarter shows that 3,177,038 units were sold, representing a net increase of 3·57 per cent. over June, 1915. The net revenue from the sale of electricity and meter rentals amounted to £31,948, being an increase over last June of £1,605; improvements in sundry revenue bring the increase up to £2,480. The total expenditure for the quarter amounted to £17,281, an increase as compared with the June quarter, 1915, of £408. The total average costs per unit sold were 1·305d., as against 1·318d. for the previous June quarter. The result of the quarter's working shows a net improvement in the balance available for capital charges of £2,072, making a total of £17,945.

The Electricity Committee reports that after about three years' running of the two Oerlikon turbine sets (described in our issue of December 5th, 1913) these turbines have been opened up for examination; No. 11 was found to be in good condition, and the low-pressure wheels of No. 10 were found to be slightly corroded. During the three years these machines have run 27,009 hours out of a possible 50,352 hours, and have generated 56,032,684 units, or 84·06 per cent. of the total units generated. They have cost for repairs £45 and for oil £136, very low figures, amounting to ·00078d. per unit generated.

The Electricity Committee recommends that, owing to exceptional circumstances prevailing, an increase of wages varying from 1s. to 3s. per week be made to all male employés of the electricity supply department other than the clerical staff.

Hackney.—The Electricity Committee recommends the granting of an additional bonus of 3s. (making 5s. in all) to the men employed in the electricity undertaking and refuse destructor works, the total wages, including war bonus, not to exceed 45s. per week.

Linking-up Scheme.—The Committee also recommends that, subject to the North Metropolitan Electric Power Supply Co. agreeing to the terms and conditions of an agreement to be approved by the Electricity Committee, on behalf of the Council, and subject to the approval of the B. of T. and the L.C.C., the necessary steps be taken to proceed with the linking-up of the two undertakings, at an estimated cost of £6,500.

Revision of Charges.—The Electricity Committee further recommends the following additions to the present scale of charges for electricity for lighting and power, as from the reading of the meters for the December quarter, a fixed minimum charge of 7s. 6d. per quarter for lighting, and 10s. per quarter for power; a percentage increase for electricity for lighting from 17½ per cent., less 2½ per cent. to 20 per cent., less 5 per cent. for prompt payment, and for power a percentage increase of 30 per cent. above normal rates, less 5 per cent., in lieu of 17½ per cent. less 2½ per cent.

The Committee recommends that, in view of the high cost of fuel and the difficulty of obtaining labour, the official test of the 5,000-KW. turbo-alternator be carried out on the town load, instead of an artificial load, the contractors being willing to make a deduction of £120 if the test is so carried out.

An explosion and fire occurred at the Smithfield Markets Electric Supply Co.'s premises on the 11th inst., which resulted in both light and power being cut off in the market and cold storage. The *Meat Trades' Journal* comments on the absurdity of depending on a single source of electric supply, but probably the movement in favour of linking-up electricity undertakings will remedy this in the near future.

Luddenden Foot.—Provisional Order.—The Yorkshire Electric Power Co. has notified the U.D.C. that, as the B. of T. is now prepared to consider the granting of provisional orders for public works, the company proposes to proceed with its orginal scheme of applying for a lighting order for the district.

Nuneaton.—The T.C. has decided to extend the mains, at an estimated cost of £500, which will be met out of the proceeds of the sale of a generator; the present revenue from the extension will be about a £100 a year. From October 15th the charge for current for power is to be increased by 10 per cent.

Radcliffe.—Bulk Supply.—The U.D.C. has notified the Bury Corporation that it intends to exercise its option of renewing the agreement in respect to the supply of electricity in bulk for a further period of five years.

Redruth.—Public Lighting.—The Lighting Committee reported that a further concession of £92 has been obtained from the electric supply company in consequence of reduced lighting, making £174 in all. The total contract was for £552 per annum.

Salford.—Daylight Saving.—The electricity department estimates that the Summer Time Act has led to a reduction of £2,500 in the value of the current consumed for lighting purposes; this represents a saving of 1,100 tons of coal. With coal at 17s. 8d. a ton, the estimated net loss to the department is about £1,500, but the increase in the demand for power more than counterbalances the loss of revenue due to daylight saving.

Southend-on-Sea.—It has been agreed to allocate £6,000 from the electricity undertaking for the relief of the rates.

Stafford.—Price Increase.—The T.C. has decided to increase the price of energy for lighting to 7½d. per unit, less 5 per cent. for prompt payment of accounts, as from October 1st last.

Sunderland.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to the borrowing of £45,246 for plant extensions at the electricity works. It is proposed to add a 7,500-kw. turbine unit, bringing the plant capacity up to 14,200 kw.

Tasmania. — Hydro-Electric Developments. — In view of the increased demands which it is expected will be made by metallurgical undertakings upon the Government Hydro-Electric Department for power, it is understood that steps are being taken to obtain data respecting Lake St. Clair, situated some 25 miles westerly from the Great Lake. Lake St. Clair, it is stated has a surface area of about 30 miles, and varies in depth to 600 ft. If anticipations are realised, a fall of approximately 1,000 ft. will be obtainable when this supply is harnessed. The general programme of the Tasmanian Government in connection with hydro-electric power for industrial purposes has been outlined in Ministerial statements already published. Unofficial estimates have been made giving the present nominal capacity from the existing works at the Great Lake as equal to some 10,000 h.p., and the approximate total which may ultimately be developed as up to 100,000 h.p.—*British Australasian.*

The *Commonwealth Engineer* recently published a letter from Mr. J. H. Butters, chief engineer of the Hydro-Electric Department, which, amongst other things, stated that the department has so far entered into the following contracts only:—3,500, rising to 10,000 h.p., to the Metallurgical Co.; 30,000 h.p. to the Amalgamated Zinc Co.; and 2,000 h.p., plus normal development, to Hobart and suburbs. The Government has made no contract with the Mount Lyell Co., but has under consideration the supply of up to 50,000 h.p. to it, not from the Great Lake scheme, but from other sources. Data collected in connection with the Great Lake dam shows that the figure of 35,000 h.p. (all day and night) is conservative and 50,000 h.p. continuously could be obtained, or, with subsidiary power, 55,000 h.p.

Wakefield.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £3,000 for the provision of an economiser at the electricity works.

Watford.—No Linking-up.—The Electricity Committee is of opinion that no advantage would be gained by way of linking-up, and that it should take no part in the conference being called to consider the matter.

Winchester.—The T.C. has sent out circulars to small consumers of current, inviting them to increase their consumption to the value of £2 6s. 8d. per annum, so as to avoid the necessity of enforcing the minimum charge which the Corporation is entitled to make.

TRAMWAY and RAILWAY NOTES.

Australia.—The financial statement of the Adelaide Municipal Tramways Trust for the half-year ended July 31st last, for which we are indebted to Mr. W. G. T. Goodman, the chief engineer, shows that there was a gross balance after meeting working expenditure on the Adelaide and Port Adelaide systems of £65,409, which, with the balance of £3,164 brought forward, made a total of £68,573 for appropriation. From this £9,069 was taken for renewals, £27,071 for interest, £24,251 for sinking fund and other amounts for interest, leaving £3,876 to be carried forward.

The gross revenue was £10,506 better than in the corresponding period of 1915.

The renewals account now amounts to £107,581, the sinking fund account to £203,683, and the insurance reserve to £8,985.

Electrification of Cable Tramways.—The Melbourne City Council has adopted the recommendation of the Public Works Committee that the Government be urged to provide for placing electrical equipment underground if it is decided to electrify the cable tramway. The Lord Mayor stated that any suggestion to install the overhead system of electric traction would meet with the Council's strongest opposition.—*Melbourne Age.*

The Victorian Government proposes shortly to introduce a Bill for the permanent control of the metropolitan tramways, both cable and electric; the Bill will also provide for payment of compensation to the Railway Commissioners for the loss of revenue on suburban railways affected by the competition of tramways. The proposed new authority will also take over the electric supply and control of parks and gardens.

The Melbourne City Council has decided to oppose any Bill of this nature.

Birmingham.—The local papers refer at considerable length to the possible stoppage of the tramways during periods when the city power stations are unequal to the great demand being made upon them at the present time. The Electric Supply Committee, in a report, states that in a year the maximum demand rose by 12,000 kw., thus exceeding the 10,000 kw. of new plant brought into use. The coal conveyors at Summer Lane station were provided for 26,500 kw., but 36,500 kw. of plant is now installed, and the conveyors, due to the heavy duty, are in need of substantial repairs. A larger proportion of better-class coal is to be employed, and an order has been placed for new conveyor parts, an additional chimney and economiser, and for increasing the areas of the grates. The tramway stoppage of Wednesday, last week, was due to a turbine breakdown at the Nechells station, which it is now stated will be put right within 10 days. The tramway department has made arrangements to provide conductors with "breakdown" tickets to exchange for those held by passengers in cars which are held up, such tickets being available for the remainder of the journey at a later date.

Burnley.—Free Tickets.—The Tramways Committee has decided to recommend the T.C. to provide special free tickets for wounded soldiers, entitling them to travel either singly or in parties on any car, at any time, and from or to any point on the system of the local tramways.

Canada.—It is stated that the Canadian Pacific Railway will electrify its line between Kingston and Renfrew in the near future, and that a power plant will be installed on the Mississippi river at Sharbot Lake to develop power for this project as well as to supply current to Kingston and vicinity.—*Canadian Electrical News.*

Continental.—Italy.—The Central Umbrian Railway, opened provisionally with steam traction, will next year be converted to electric working, the current being supplied by the Società dei Carburo di Calcio. Energy from the station at Papigno will be transformed at Marsciano to single-phase current for the supply of the contact lines, which will be on the catenary system. The traffic will be worked by locomotives, each equipped with four single-phase motors of 90 h.p. each.—*L'Ingeneria Ferroviaria.*

Norway.—It is proposed to start a company to manufacture electric automobiles. The share capital required is estimated at 800,000 kroner, working expenses at 270,500 kroner, and the receipts at 420,000 kroner per year. Output is estimated provisionally at 160 motor-cars yearly. Later the building of automobiles *de luxe* is projected.

It is under consideration to convert to electric working the railway line from Bergen to Nestun, the power to be drawn from the Bergen municipal station.

The plans are being prepared for the construction of an electric railway to connect Trondhjem with Fjeldsseter, the scheme having Government approval.

Spain.—La Socidedad Tranvias de Zaragoza has drawn up a scheme for the construction of a further line of electric tramway in the town of Saragossa; in accordance with the usual plan in that country, the carrying through of the project is being put up by the Goverument to public tender.

A new company is reported te be in course of formation at Aviles with the object of constructing a new electric tramway to connect the towns of Villalegre, Aviles and Castrillon.

Dublin.—The receipts of the Dublin United (Electric) Tramways Co. for the half-yearly term show an aggregate to October 13th of £249,786, as against £251,240 in the corresponding period of last year, a decrease of £1,454. The weekly receipts have shown a steady increase of late, and there can be no doubt that the half-year will conclude with a substantial balance to credit.

Ealing.—As a result of negotiations, the Council has agreed not to press the London United Tramways Co. in regard to reconstruction of tracks after the war, if the necessary work of improving the condition of the track is carried out now.

Glasgow.—Through dissatisfaction with the attitude taken up by the management, the position of the engineers in the employment of the Tramways Committee is again expected to be brought before the local Munitions Tribunal. Failing an amicable settlement, the probability is that the men will, under the terms of the Sheriff's award, make application for their clearance certificates. Close upon 1,000 men are affected.

Lanarkshire.—Women car conductors in the employment of the Lanarkshire Tramways Co. are threatening to resign in batches, owing to the prevalence of hooliganism in the districts tapped by the system. The company has issued posters threatening to discontinue the early morning service and all cars after dusk, unless the rowdy element immediately disappears.

Oulton Broad.—Bulk Supply.—The Lowestoft T.C. has decided to continue on the same terms the supply of current in bulk to Oulton Broad.

Southend-on-Sea.—The engineer has reported on the difficulty of dealing with rail corrugation under present conditions, and of keeping the cars in repair—due to the restricted supply of material. Arrangements are to be made, if possible, to permit of the rail corrugation machine being used when traffic is suspended.

It has been decided to allocate £3,300 from the tramway funds in relief of the rates.

WAGES.—The Tramways Committee has resolved that male drivers, conductors, and inspectors with 12 months' service be granted a war bonus of 2s. per week, additional to the existing war bonus of 2s. per week.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The Government has completed the purchase of the Shaw Wireless, Ltd., works for £55,000. The founder of the concern, the Rev. A. J. Shaw, died in Melbourne on August 26th.

The plant is said to be capable of producing most of the requirements for wireless equipment. The wireless system in Australia is now controlled entirely by the Navy Department. The works of Shaw Wireless, Ltd., will become a naval establishment, but work will also be performed for the postal and defence departments. It is also probable that the system of wireless telegraphs in Australia, now confined to the coast, will be extended inland.

Mr. Balsillie, the wireless expert, who has been making experiments in the matter of causing rain by wireless waves, states that he has proved conclusively that rain can be stimulated by electrical means. His experiments have proved that at least 30 per cent. of the stimulation can be maintained. He emphasises the point that he does not claim to produce rain—only to stimulate light showers.—*Auckland Weekly News.*

Manchester.—There was a large attendance of the telegraph and telephone workers of Manchester and the surrounding districts at a meeting, on Sunday, at which a resolution demanding arbitration respecting their claim for wage increases of 3s., 4s., and 5s. was passed. The resolution further declared that the advances offered by the Government were quite inadequate.

New Zealand.—The Auckland wireless station, which has been closed since May, 1915, has been reopened.

The Government has decided to erect a wireless station at Rarotonga, which will constitute another link in the Empire, as many islands of the Pacific, such as Samoa and Fiji, will be brought into closer touch with New Zealand, and, consequently, with other portions of the Empire. The work will be carried out by the Post and Telegraph Department.

The Government is to enter into an agreement with the Eastern Extension Cable Co. with regard to a proposal to remove the cable station from Wakapuaka to Wellington.—*Auckland Weekly News.*

Russia.—The Russian Government has requested the Great Northern Telegraph Co. to recall all the Danish operators employed at the company's stations in Russia, including Petrograd, for the duration of the war, and replace them by Russians. No foreigners are to be employed in future in the Russian Postal or Telegraph Service.

Spain.—It is reported that the Spanish Ministry of Posts and Telegraphs is contemplating the purchase of a steamer specially equipped for the repair of the submarine telegraph cables owned by the Spanish Government.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—January 22nd, 1917. Electrical plant (converter, battery, booster, and switchboards) for the Castlereagh Street sub-station, for the Municipal Council. Specification from E.L. Department, Town Hall.*

January 8th. Municipal Council Electric Lighting Department. 33,000-volt switchgear. E.L. Department, Town Hall. Specification 10s. 6d.

MELBOURNE.—October 31st and November 8th. Deputy P.M.G. Telephone parts; switchboard; instruments, &c. Schedules Nos. 1,363, 1,364, and 1,368.*

December 11th. City Council. Supply and erection of coal transporter plant. See "Official Notices" September 15th.

PEETH.—November 8th. P.M.G. Accumulator parts (Schedule 527 W.A.).*

SOUTH AUSTRALIA.—November 15th. P.M.G.'s Department. Automatic switchboards and all associated apparatus, for telephone exchanges, Brighton and Glenelg.

Dublin.—November 2nd. Great Northern Railway Co. (Ireland). Contracts for general stores for 12 months (including several electrical items). See "Official Notices" October 13th.

Johannesburg.—November 13th. South African Railways Administration. 71,778 tungsten drawn-wire lamps, 19,741 solid-drawn tungsten lamps, and 2,412 carbon-filament lamps.*

November 20th. Corporation. 500 or 1,000 trolley wheels for tramcars (Contract No. 181).*

November 27th. Corporation. 1,000 sets of single-pole, ironclad house-service cut-outs (Contract No. 187).*

Manchester.—October 24th. Corporation Tramways. Hard-drawn copper trolley wire. Mr. J. M. McElroy, General Manager, 55, Piccadilly, Manchester.

New Zealand.—DUNEDIN.—January 24th, 1917. Motor-generator, accessories and spares. City Electrical Engineer, Market Street, Dunedin.*

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Glasgow.—The Tramways Committee recommends for acceptance the tender of Messrs. Edgar Allen & Co., Ltd., for special trackwork.

London.—The Metropolitan Asylums Board reports that the agreements with the Tudor Accumulator Co. for the maintenance of the batteries of electric vehicles Nos. 2 and 3, at Queen Mary's Hospital, expired on September 26th. The assistant engineer states that the present is a very unsatisfactory time for entering into new contracts of this description, owing to the high cost of materials, and he advises that the existing agreements should be extended for a period of 12 months, which the company is willing to agree to. The agreements provide for the payment of 1¼d. and 1½d. per mile run respectively for the two vehicles, one of which is 25 cwt. and the other 30 cwt. The Committee recommends that the agreements be so extended.

L.C.C.—The Stores and Contracts Committee reports that the current contracts for the supply of general stores, including electric cables, lamp fittings, &c., will expire on December 31st next. For the supply for 1917 the Committee proposes to continue the present practice of purchasing some classes of goods at the current market rates or under special quotations; in other cases new forms of tender and schedules are being prepared. The tenders will be received early in November, and, as the number will be comparatively large, the Committee recommends that it be authorised to open the tenders to be received for the supply of goods included in the general stores section, 1917.

MARYLEBONE.—The Electricity Committee reports that, owing to the fluctuations in the prices of materials and the abnormal conditions generally, it is not possible to obtain satisfactory tenders for goods or to enter into acceptable contracts. The Committee has therefore authorised the general manager to purchase such goods as are required in the open market on the best terms obtainable, and to report all such purchases to the Committee.

Malvern.—U.D.C. Coal (500 tons of Highley slack) for the electricity works: South Wales & Cannock Chase Coal Co.

Paisley.—Corporation. Tenders for new high-tension switchboard:—

British Thomson-Houston Co., Ltd.	£2,862
British Westinghouse Electric, &c., Co., Ltd.	2,868
Siemens Bros. Dynamo Works, Ltd.	2,693

It was agreed to accept the offer of Messrs. Siemens Bros., as being the lowest, delivery to be made within 18 weeks.

Spain.—La Compania Electrica del Urumea, of San Sebastian, has just placed a contract with Messrs. Piccard. Pictet and Co., of Geneva, for the construction of a 2,300-H.P. hydraulic turbine, designed to work under a head of about 600 ft. and to run at a speed of 500 R.P.M. A 1,600-KW. three-phase alternator to run in conjunction with the same machine has also been ordered from Messrs. Brown, Boveri & Co., of Baden.

Wakefield.—Corporation:

E. Green & Son, Ltd.—Foundations and brickwork for an additional economiser at the electricity works, £624.
Sturtevant Engineering Co.—New chimney, £890.

Walthamstow.—U.D.C. 152 time switches for street lighting: Venner Time Switches, Ltd.

Wednesbury.—T.C. 500-KW. rotary converter, with transformer, starting and switch gear, duplicate main and ventilating gear: British Westinghouse Electric & Manufacturing Co., Ltd., £3,190.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, October 20th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, Westminster, S.W. Paper on "Trials on a Diesel Engine, and Application of Energy Diagram to obtain Heat Balance," by the late Lieut. Trevor Wilkins, to be presented by Professor Burstall.

Institution of Electrical Engineers (Western Local Section).—Monday, October 23rd. At 5.10 p.m. At Merchant Venturers' Technical College, Bristol. Address by the chairman, Prof. D. Robertson.

Institution of Civil Engineers.—Tuesday, October 24th. At 5.30 p.m. At Great George Street, Westminster, S.W. James Forrest Lecture, "The Development of Appliances for Handling Raw Materials and Merchandise at Ports and other large centres of traffic," by Sir J. P. Griffith.

NOTES.

Engineers' Wages.—A Conference of representatives of the Engineers Employers' Federation and the Amalgamated Society of Engineers and kindred allied trade organisations was held at York, when the question of increases in wages was discussed. The proceedings lasted all day, but no satisfactory result was arrived at. The application of the engineers was for an advance of 9s. per week. It is believed an offer of 6s. per week was made, but this was not acceptable to the men's representatives. The question will now be referred to the Government Productions Committee.—*Morning Post.*

Memorial to Sir Wm. Ramsay.—A meeting to consider the steps to be taken to raise a memorial to the late Prof. Sir William Ramsay, K.C.B., F.R.S., will be held at University College, London, on Tuesday, October 31st. After the meeting, the Director of the University College Chemical Laboratories, Prof. J. Norman Collie, F.R.S., will deliver a memorial lecture on "The Scientific Work of Sir William Ramsay."

Copper Prices.—The Week's Changes.—Messrs. F. Smith & Co. report, Wednesday, October 18th :—Electrolytic bars rose from £142 to £143 ; ditto sheets, from £160 to £161 ; ditto rods, from £151 to £152 ; ditto H.C. wire, no change.

Messrs. James & Shakespeare report, Wednesday, October 18th :—Copper bars, sheets and rods (best selected) rose from £166 to £168.

Strength of Copper Wire Splices.—The U.S. Bureau of Standards has recently made a number of special transmission line studies in attempting to prescribe suitable sags in line conductors which would at once meet the requirements for proper unit stresses under the maximum assumed loading conditions, and also provide reasonable assurance against their blowing together in the wind.

Tests were made on the mechanical strength of Western Union and sleeve splices, and an investigation was made to determine the relative hardness of the surface and interior of different grades of copper, as well as their ability to withstand injury and vibration.

Specimens of No. 6 medium wire broke at 1,135 lb., or 51,100 lb. per sq. in. A Western Union splice without solder broke at 449 lb., showing very little strength unless the splice is soldered. Two Western Union splices were made up very similarly, but one was heated in the soldering process to a very much higher temperature than the other ; one broke at 751 lb. at a point close to the splice, where the effect of the heat had annealed it. The other wire was not heated to such a high temperature, and went to 1,077 lb., nearly the full strength of the wire. A sleeve splice failed at about the same as the soldered splice, 1,035 lb., which is practically the full strength of the wire.

Hard-drawn wire or medium wire will anneal at about 250° C., or, perhaps, something under that temperature, if held there for some time. Solder will flow somewhere in the neighbourhood of 190° C. There is a margin which is not very great, some 50 or 60° C., in which soldering can be done without any serious injury to the wire.

The failure of a soldered joint occurs not in the joint itself, but usually just outside of the splice where the wire has been overheated. If this weak section is kept below the annealing temperature, a strong splice will result, even though the middle region of the splice be heated to a much higher temperature. If the soldering can be confined to the middle region of the wire, and not extended to the end turns, which contribute little or no strength to the splice, a stronger joint will be obtained with less injury to the leading-in wires, as well as with a saving of time and material.

All of the soldered splices tested were made up with a blow torch. Pouring from a ladle, however, is not so likely to overheat the wire, and this method is exclusively used by some companies.

No. 4 medium wire broke at 1,632 lb., or 49,800 lb. per sq. in. Two Western Union splices went to 1,428 and 1,465 lb. In one of these the wire broke about 1 in. outside of the splice, which may have been due to some injury there. Neither was injured very much by the high temperature. A sleeve splice failed at 1,540 lb., or about 95 per cent. of the full strength of the wire. It requires from three to three and one-half turns in the sleeve to secure this high per cent. of strength. It was found that in every case where the wires were sandpapered before inserting them in the sleeve, a greater strength was obtained, particularly on greasy bare wires.

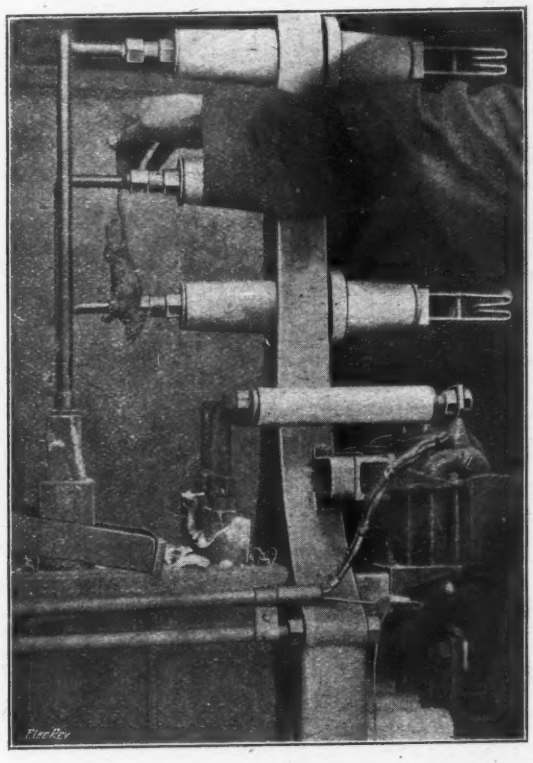
In the small sizes it is very easy to overheat the wires, and great care must be exercised. The larger wires conduct the heat away better, and are not so liable to be overheated. Sleeve splices, with proper care, can be made to develop practically the full strength of the wire, or within a few per cent. of the full strength.

Some tests were made to determine the effect of reducing the section of the wires. A No. 6 wire, which was etched down with acid from 165 to 143 mils, broke at 63,200 lb. per sq. in. The corresponding figure for the full section is 62,000, so that it had been raised from 62,000 to 63,200 by taking off the outer shell, showing that the unit strength of the core is a little greater than that of the full section. These experiments were continued on No. 00 trolley wire, hard-drawn, where similar results were obtained. From these tests it appears that the core of the wire is just as hard as the shell. To substantiate this, Dr. Merica, of the Metallurgical Division, made some microscopic examinations of these wires. His results show absolutely no difference in the grain structure across the section of any one wire, but widely different structures between wires of different sizes and grades.

In order to determine the effect of injury and vibration on wires, a vibrating machine was built, and some vibration tests were made on a number of wires. From these incomplete experiments it would appear that, for simple vibrations, the harder the wire the better it will stand up. Soft wire seems to crystallise very quickly. It is not always the simple vibration that determines the life of the hard-drawn wire. If a hard wire is kinked, and an attempt is made to remove the kink, the wire will break, while soft wire will not.

While hard and medium wire may in some respects be objectionable for general line use, it is believed that the experiments here recorded demonstrate that there are no serious limitations to its use. It has fewer disadvantages, and soft copper more disadvantages, than have generally been recognised.—E. R. Shepard, in the *Electrical World.* (Abstract.)

"Ha!—a Rat!!"—How much damage can be done in a moment by a rat bent on exploration—a successful quest, if currents were the object of it—is well shown in the accompanying illustration, for which we are indebted to a lady switchboard attendant, Miss E. H. Smith. The tragedy occurred in the Oldbury substation of the Shropshire, Worcestershire and Staffordshire Electric



Power Co. The rat climbed into the cubicle of the truck gear and got across the high-pressure conductors, tripping every breaker and causing a complete shut-down for an hour, last Friday. The damage done was estimated at about £30.

Nitrogen from the Air.—In a letter recently addressed to the *Times*, Mr. J. Orchiston, M.I.E.E., chief engineer of telegraphs, Wellington, N.Z., points out that the South Island of New Zealand is richly endowed with magnificent water powers, many of them coming right down to the water's edge in the sounds on the south-west coast. Water powers ranging up to 40,000 H.P. can be obtained at an expenditure of from £5 to £10 per H.P. for the hydraulic development, and in many cases no transmission lines would be needed, as the power station could be located alongside deep water. Heads ranging from 500 ft. to 1,000 ft. or over are procurable, so that the conduits, piping, water-wheels, foundations, &c., need be only of minimum dimensions for the output developed. In some cases less than a mile of piping is all that would be required to utilise a head of 1,000 ft. with a constant flow ranging up to 500 cb. ft. per second, fed from glaciers.

By the construction of a tunnel about five miles in length, mostly through granite, the whole of the discharge of the Te Anau Lake, covering an area of 135 sq. miles, could be diverted to one of these sounds, giving an effective head of nearly 600 ft., and a constant discharge exceeding 12,000 cb. ft. per second. Few countries can so easily provide a power of such dimensions (approximately 700,000 H.P.) at the edge of a deep-water harbour. There are numerous other water powers available inland, ranging up to 100,000 H.P., which could be developed at very low cost, but they are at present not conveniently located for transport purposes, and would involve fairly long transmission lines.

These waterfalls are located on Crown lands, and before action could be taken for their utilisation a permit would have to be obtained from the Dominion Government, who would no doubt give a willing ear to any proposal which would be the means of bringing capital to the countr and the development of new industries.

Fatalities.—Newcastle.—An inquest has been held upon the body of a boy named George W. Armstrong, who was killed by an electrically-driven wheel at the Elswick Works of Messrs. Armstrong, Whitworth & Co., Ltd. A work-mate said he saw deceased with his head under the 2 ft. 9 in. fencing round the ropes driving the wheel. The lad then suddenly slipped or overbalanced, and fell on to the ropes. All that witness saw after that was portions of his body flying about. The motorman in charge said it took the wheel seven or eight minutes to come to a standstill after the current was shut off. The Coroner observed that deceased was the victim of boyish curiosity, and the jury returned a verdict of "Accidental death."

Acton.—According to a weekly newspaper Walter Permain, thirty-nine, an electrical engineer, of Acton, was killed by electric shock while at work on overhead electric wires at an Acton factory. Verdict, "Accidental death."

Rotherham.—A verdict of "Accidental death" was returned in the case of G. E. Smith, forty-three, an electrician of Rotherham, whose death followed burns sustained at the works of Messrs. Thomas Firth & Sons on October 3rd.

Sheffield.—An inquest was held on October 12th into the death of B. F. Theaker, aged twenty, labourer to an engineer's fitter, who was killed while working upon the fitting of a new brake on an electric crane. It appeared from the evidence that Theaker's forearm came into contact with 200-volt live wires while climbing down into the cage containing the operating handles. When the current was cut off he fell 6 ft. into the cage below. The medical evidence showed that death was due to electric shock. The works superintendent said that the current should have been switched off before Theaker went up to do the work.

Bargoed.—S. H. Chester, aged sixty-two, an assistant at the P.D. Colliery, Bargoed, was killed last Sunday week while at work on a girder 22 ft. from the ground. He lost his hold and fell backwards. There were three 3,000-volt power lines passing in proximity to the girder; the wires were on china insulators and insulated from the girder. They carried power to the motors which drove an aerial ropeway. The medical evidence showed that there were no signs of Chester having been burnt by electric wires. Verdict, "Accidental death."

Bell Signalling in Mines.—The Chief Inspector of Mines, Dr. R. A. S. Redmayne, has issued a circular drawing attention to the report of Dr. Wheeler and Prof. Thornton on electric signalling in mines (abstracted in our issue of August 11th), and stating that in mines to which Regulation 132 applies, steps must be taken without delay to bring into compliance with the Regulation any existing installations which do not already comply. No new apparatus may be installed except such as complies strictly with the Regulation. The maximum pressure of 25 volts allowed for a signalling circuit is unchanged, provided that wet Leclanché cells (quart size) are employed. Systems using dry cells or accumulators, or in which D.C. or A.C. generators are employed, can be made safe if, in addition to the use of anti-sparking devices, sufficient non-inductive resistance is permanently installed in the circuit. Bells and relays should have flame-tight covers (preferably locked), and should be so constructed and maintained that when included in a circuit with a battery at 25 volts, the break-flash produced when bare signal wires are separated after giving a signal is incapable of igniting an 8 per cent. methane-air mixture.

Legal.—At the Manchester City Police Court recently, according to a local paper, W. P. Theermann, a German subject, managing director of W. P. Theermann & Co., Ltd., electrical engineers, Manchester, was fined £10 for constantly using the telephone on his premises since the outbreak of war without obtaining a permit.

The Decimal System.—Supporters of Decimal Coinage and the Metric System recently decided to form a "Manchester and District Decimal Association," and a meeting was called by the Lord Mayor, with a view to ascertaining whether the time was ripe for such a movement. The following resolutions were unanimously adopted :—

1. That steps be taken forthwith to form an Association to be called "The Manchester and District Decimal Association," with powers to examine relevant questions, and, if thought fit, to advocate, either independently or in conjunction with others, the early adoption by the British Empire of a suitable system of decimal coins, weights and measures.

2. That the Lord Mayor be the first president of the above Association, and that Messrs. Noton Barclay, Astbury, Cowan, and Allcock be, and they are hereby appointed, a nucleus Committee, with powers to add to their number, for the furtherance of the above objects.

Mr. Harry Allcock, M.I.E.E., was elected hon. secretary, and is now compiling a list of local supporters, and the Committee hopes to proceed with the work of organising the Association in the immediate future.

British Department of Minerals.—Last month a proposition to form a central Department of Minerals and Metals was laid before the Advisory Council for Scientific and Industrial Research by the Councils of the Iron and Steel Institute, the Institute of Metals and the Institutions of Mining Engineers and Mining and Metallurgy. The proposed department would push forward mineral surveys of the Empire, collect and co-ordinate information on the occurrence and uses of minerals and on mining laws, &c., and advise the Government on all questions within its purview.

National Electric Power Supply.—Greater London Area.—At a meeting of the Joint Committee of Engineers appointed by the Engineers' Committee of the Conference of Local Authorities in Greater London owning electricity undertakings, held at the Institution of Electrical Engineers on Friday, 13th inst., Mr. J. S. Highfield (Metropolitan Electric Supply Co.) stated that the National Power Supply Joint Committee did not propose to convene a Committee for the Greater London area, as it was hoped that the Committee appointed by the Conference would act in conjunction with the National Committee. It was resolved that :—"A formal notice be sent to the secretaries of the National Committee stating that a conference had been formed of representatives of private and public interests, to consider the best method of linking-up generating stations in the Greater London area."

The Joint Committee is constituted as follows, viz. :—

Companies.

The Charing Cross, West End and City Electric Supply Co., Ltd.
The City of London Electric Supply Co., Ltd.
The County of London Electric Supply Co., Ltd.
The Kensington and Knightsbridge Electric Lighting Co., Ltd.
The London Electric Supply Corporation, Ltd.
The Metropolitan Electric Supply Co., Ltd.
The Westminster Electric Supply Corporation, Ltd.

Municipalities.

Mr. G. G. Bell, Hammersmith.
Mr. F. A. Bond, Battersea.
Mr. E. Calvert, Finchley.
Mr. A. C. Cramb, Croydon.
Mr. L. L. Robinson, Hackney.
Mr. W. C. P. Tapper, Stepney.

Mr. C. A. Baker (London County Council).

Mr. E. T. Ruthven Murray (North Metropolitan Power Supply Co., Ltd.).

Mr. H. W. Firth (Great Eastern Railway), with Messrs. F. J. Walker (St. James' and Pall Mall Co.) and Fred. Tait (Poplar) joint honorary secretaries.

A Large Searchlight.—The General Electric Co., of Schenectady, N.Y., has lately completed, for the U.S. Navy, a searchlight with a 5-ft. mirror, the rays of light from which can, it is claimed, be seen at a distance of 200 miles.

Coal Research.—In his capacity as one of the largest coal consumers in the country, the central-station engineer must henceforward take keen interest in the efficient utilisation of our great national asset. Whilst it is too much to expect that the electrical engineer should also be an expert fuel technologist, the "chief" must be able to appreciate and utilise the services of a trained chemist on his staff. Much has yet to be learned concerning the products derived from the distillation of coal by various processes, and Germany has paid more attention than we to this matter in the past. The Kaiser Wilhelm Institute for Coal Research, inaugurated at Mulheim a.d. Ruhr shortly before the war, has just issued a report presenting the following information :—(1) By washing coal with liquid sulphuric acid at room temperature a thick golden yellow mineral oil is obtained, having a not unpleasant smell. From 1 kg. of ordinary coal about 5 gm. of this oil are obtained. Using benzol under pressure, about 60 gm. of material can be extracted, but this contains only a small proportion of oil. By the separation of this component, the coal loses its tenacity and falls to powder. (2) By distilling coal with superheated steam, a tar is obtained which contains petroleum-like optically active oil, lubricating oil, and paraffin. (3) By treatment with ozone, over 92 per cent. of coal can be converted into a brown mass smelling like caramel, soluble in water, and of unknown composition. (4) By a new process about 20 per cent. of ozokerite can be obtained from lignite, instead of 12 per cent., as heretofore.

Institution and Lecture Notes.—Textile Association.—At the seventh annual congress of the Textile Association, which was opened at Leeds University, on Friday last, Dr. S. A. Shorter, of the University, and Mr. Howard Priestman delivered a paper and demonstration on "The Electrification of Textile Fibres," showing the conditions under which wool, silk, cotton, flax, &c., may become electrified, and the use of certain methods of de-electrification. Dr. Shorter pointed out the elementary principle that electrification was most pronounced in the case of bad conductors, on which the energy generated was retained, and added that as water was a good conductor, it naturally followed that moisture in any substance tended to diminish electrification. Silk was the most readily electrified of fabrics, owing to its low conductivity, but all textile fabrics became electrified. The mere drying of substances was sufficient to produce electrification to some extent. The energy might be discharged in various ways—by radio-active substances, X-rays, ultra-violet light, and the connection of points.

In a later lecture and demonstration on "The Scientific Principles Underlying the Process of Textile Scouring," Dr. Shorter showed, by experiment and demonstration, that whilst the first principle in the washing of an object or material was the emulsification of the grease which acted as a binder for the dirt particles, produced by a lowering of the surface tension between the water and grease, it was a negative electrical charge which prevented the oil droplets and the dirt particles from coagulation, this negative electrical charge being increased by the presence of alkali.

Amongst other various demonstrations at the Congress were those in speed and power consumption recording, by Mr. A. Yewdall, showing the value of employing the tachograph for registering the regular or irregular running of textile machinery, and the dynamometer for registering power consumption.

Repeated reference was made, in the course of the proceedings at the Congress, to the important scheme of research into the electri-

fication of fabrics which is being conducted at the University, under the aegis of the Textile Institute, by Dr. S. A. Shorter. It was through the interest of Prof. W. H. Bragg (Quain Professor of the University of London) in electrical phenomena in the wool manufacturing processes, that the Institute was led to inaugurate and maintain at Leeds University a research worker, in the person of Dr. Shorter, into this question. Prof. Bragg himself, in a general address at the opening of Congress, quoted wireless telegraphy as an illustration of the fact that scientific research was a series of utter surprises and discoveries, bit by bit, of things which made the extension of our powers possible, and not merely the forecasting of wonderful things in the future, based upon extension of things which we knew at present. He urged all engaged in manufacturing of any kind to encourage pure and applied science by every means in their power.

At the opening proceedings on the second day of the Congress, the chairman (Mr. Frank Warner, President of the Silk Association) drew attention to the two main objects of the Institute, which were, first, to spread and increase knowledge of existing methods and operations; and, secondly, to advance the general interests of the industries by means of scientific research. This latter work, he said, was now coming very much to the fore, and one of the most important researches already proceeding was that in Leeds by Dr. Shorter on the electrification of fibres. Though no report was yet available, he was informed that there had been a good deal of enlightenment already on many hitherto obscure points in the application of electricity to textile fabrics.

For these researches, the Textile Institute has a special fund. The figure up to the time of the Leeds Congress had reached £243, but it is estimated that £1,000, spread over a period of three years, will be required for the research, and it is confidently expected that that sum will be secured. Several of the subscriptions already are annual ones.

Society of Engineers.—At the ordinary meeting of the Society, to be held at the apartments of the Geological Society, Burlington House, Piccadilly, W., on December 11th, at 3 p.m., two papers will be presented for discussion dealing with the sources of minerals and mineral ores required in the engineering industry of the United Kingdom. The first paper will be presented by Prof. W. G. Fearnsides, M.A., Sorby Professor of Geology at the University of Sheffield, and will deal with the minerals required by the iron and steel industries. The second will be presented by Prof. C. G. Cullis, D.Sc., M.I.M.M., Professor of Economic Mineralogy at the Imperial College of Science, and will deal with non-ferrous ores.

As the subject for discussion is of exceptional interest at the present time, and a large number of eminent engineers and metallurgists will be invited to attend, the Council has decided to throw the meeting open to the public by tickets, which may be obtained (gratis) on application to the Secretary, 17, Victoria Street, S.W. Tea and light refreshments will be provided at about 5 p.m.

Manchester Association of Engineers.—In the course of his presidential address, Mr. F. W. Reed said that the sudden change-over of our manufacturing resources from war work to civil work would be a task of considerable magnitude. A great quantity of additional machinery and new works which had been forced into existence by the war would be available, and could, no doubt, be largely utilised for civil work. The Government would be well advised, when adjusting war taxation, to see that our industries were not impoverished. It was necessary to come to a general understanding with reference to apprentices in all the various branches of the engineering trades. They did not pay sufficient attention to the matter of the encouragement and training of apprentices. They must consider how to make the best use of adult and other labour trained in mechanical operations during the war. Arrangements might be considered for the rewarding of individual effort. Mr. Reed suggested the formation of a Central Engineering Board, composed of representatives of employers and labour, whose business it should be to arrange rules and regulations to govern employment to suit modern conditions. It would be the means of preventing misunderstandings, would tend to ensure continuity of work, and might form a final court of appeal for the settlement of labour and wage disputes.

Institution of Electrical Engineers.—The opening meeting of the session 1916-17 will take place on Thursday, November 9th, at 8 p.m., when the premiums awarded for papers read or published during the past session will be presented, and the eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," will be delivered by Dr. Alexander Russell, vice-president.

Wire Lamp Patents.—It is stated that the German Imperial Court has just given a decision in favour of the Siemens and Halske Co. in the matter of the dispute with the A.G. Julius Pintsch, which raised the question whether the latter company was justified in speaking of its glow lamps as having wire filaments, and in designating its lamps as wire lamps or Sirius wire lamps, although the filaments were not produced by the drawing process. The decision is founded upon the finding of the Lower Court that in interested trade circles something special is understood by "wire," namely, a product obtained by drawing which has been proved to possess special tensile strength. If the Pintsch Co. did not produce its filament by drawing, the Court held that it could not be characterised as wire under the special conditions prevailing in the electrical industry.

Educational.—University College, London.—A course of six lectures on "Long-Distance Telephony" will be given by Prof. J. A. Fleming on Fridays, at 5 p.m., commencing October 27th; applications for admission (fee 1½ guineas) to be made to the Secretary.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters, Chester House, Eccleston Place, S.W. Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, October 22nd.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8.

Tuesday, October 24th.—School of Arms, 6—7. Lecture, 7.15, "The Meaning of, and Necessity for, Drill," by Company Commander Fleming. Range Practice.

Wednesday, October 25th.—Instructional Class, 5.45. Platoon Drill, Platoon No. 3. Range Practice.

Thursday, October 26th.—Platoon Drill, Platoon No. 7. Range Practice.

Friday, October 27th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25.

Saturday, October 28th.—General Parade, 2.45. Uniform, for Drill. Recruits' Drill, 3.0.

Sunday, October 29th.—Entrenching at Otford.—Parade Victoria Station (S.E. & C. Railway). Booking-office, 8.45 a.m.

(By order) Macleod Yearsley, *Adjutant.*

October 21st, 1916.

Appointments Vacant.—Resident electrical engineer (£200) for the Atherton U.D.C.; resident electrical engineer (£220) for the Horsham U.D.C.; general assistant (£2) for the St. Albans Electricity Works; switchboard attendant (£2) for the Battersea B.C. Electricity Department. See our advertisement pages to-day.

Prohibited Imports.—The *Board of Trade Journal* of October 19th contains a complete list of articles the importation of which into the United Kingdom has been prohibited, except under licence, by Royal Proclamations of February 15th, 1916, and subsequent dates, and in respect of which applications for licences should be addressed to the Controller, Department of Import Restrictions, 22, Carlisle Place, Westminster, London, S.W., together with a revised list of "Interpretations" made by the Department.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Oban T.C. has appointed the assistant engineer, Mr. C. N. Saddington, as burgh electrical engineer, in room of Mr. D. McLennan, who has received an appointment in London.

Doncaster Corporation Tramways Committee has appointed chief inspector A. W. Baker to succeed Mr. Strachan, resigned, as tramway superintendent.

It is proposed to increase the salary of Mr. Whysall, electrical engineer at Greenock, by £50.

General.—The *Canadian Electrical News* states that Mr. George R. Archdeacon has been appointed general manager of the Canadian Hart Accumulator Co., the head office of which is situated at St. John's, Quebec. Mr. Archdeacon has had over 15 years' engineering experience, and was formerly upon the staff of Messrs. Ferranti, Ltd., and the Chloride Electrical Storage Co., Ltd. Mr. Archdeacon has travelled extensively in Europe and South America, and has only recently returned from China.

London Gazette Notice.—Territorial Force. Royal Engineers. Tyne Electrical Engineers. Corporal C. B. Elliott to be Second-Lieutenant (on probation).

Roll of Honour.—Lieutenant E. A. Godson, of the Royal Irish Fusiliers, a director of the Electrical Apparatus Co., Ltd., has been awarded the Military Cross.

Captain Julian North, who died at Dar-es-Salam, East Africa, on October 14th, after a severe illness, aged 35 years, was, according to the *Morning Post*, before the war an assistant superintendent in the Indian Telegraph Department.

Second-Lieutenant Roy Leslie Box, R.E., who has been killed, aged 21, was, says the *Times*, when war broke out a member of the Electrical Engineers' Corps at the City and Guilds College, London. He joined up with other students.

Saddler J. Partington, Royal Engineers, has died from wounds. He was employed at the electricity works, Spa Road, Bolton, prior to the war.

Private A. Parker, Border Regiment, already reported here as wounded in action, has since died at a Woolwich Hospital. He was 27 years of age, and previous to joining up had been in the accountant's department of the Manchester Corporation electricity department for ten years.

Lance-Corporal G. Farnsworth, King's Royal Rifle Corps, who has fallen in action, was previously a dynamo attendant at Woolley Colliery, Mapplewell (Yorks.).

Private Thos. Dawes, Grenadier Guards, who fell in action on September 23rd, at the age of 20 years, was an employé of Messrs. Johnson & Phillips, Ltd., Charlton, S.E.

Gunner W. Marsh, R.F.A., who was with Messrs. Dick, Kerr & Co., Ltd., of Preston, has been wounded in the right thigh. In October, 1914, he was wounded in the side, and was discharged from the Army, but again volunteered, and went to France a year ago.

Mr. Alfred Holmes, formerly of the electricity staff of the Warrington Corporation, who joined the Army as a private in August, 1914, has been given the warrant rank of Sub-Conductor in the Army Ordnance Corps.

Sergeant Nolan Bottwood, Signal Company, R.E., who was apprenticed at Canning's Electrical Works, at Birmingham, has been awarded the Military Medal for conspicuous service in France.

Sapper J. Slattery, who has died of wounds, was an employé of the British Westinghouse Co., at Manchester.

Private J. Letts, Lincolnshire Regiment, who has died at the Front, was formerly employed at the Lincoln electricity works.

Second-Lieutenant A. F. E. Prescott, King's Liverpool Regiment, who has been killed in action, aged 22, was a mechanical engineer in the Liverpool Corporation electricity department.

Private A. Hayes, Lancashire Fusiliers, who has died of wounds, was with Messrs. W. & T. Glover, Ltd., Trafford Park, before the war.

Lieutenant A. R. Courtenay, until recently acting manager of the publicity department of the General Electric Co., Ltd., has been promoted to a full lieutenant. Lieutenant Courtenay has had nearly nine months' service in Egypt and Salonika. He was invalided home with dysentery, but is now in good health once more, and hopes to return, before long to his former spheres of activity, whenever the Government notify that they do not require his services any longer.

Obituary.—Father Shaw.—On August 26th the Rev. A. J. Shaw, known throughout Australasia, and in wireless circles everywhere, as Father Shaw, died in Melbourne. He became interested in wireless telegraphy some ten years ago, and established workshops, which led to the erection of a wireless station at Randwick, N.S.W. He was in Melbourne negotiating the sale of this installation to the Commonwealth Government when he died, at the early age of 42.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Walter's Electrical Manufacturing Co., Ltd.—Charge on 249 and 251, Kensal Road, Paddington, dated September 29th, 1916, to secure all moneys due or to become due from company to London County & Westminster Bank, Ltd., Harrow Road, W.

Torquay Tramways Co., Ltd.—A memorandum of satisfaction to the extent of £800 on October 4th, 1916, of charge dated March 8th, 1911, securing £60,000, has been filed.

Resisto-Electrical Manufacturing Co., Ltd.—Issue on October 3rd, 1916, of £100 debentures, part of a series of which particulars have already been filed.

Brilliant Arc Lamp & Engineering Co., Ltd.—Memorandum of satisfaction in full on September 23rd, 1916, of charge dated September 25th, 1916, securing all moneys due or to become due from company to bankers, has been filed.

CITY NOTES.

Amalgamated Wireless (Australia), Ltd.

Mr. H. R. Denison presided at the half-yearly meeting of this company, held at Sydney in August. According to a Sydney newspaper, he said that the operations of the company had been considerably hampered by the war. One of the principal items in the revenue account had always been the return from its ships' message traffic; but this had been seriously restricted by the regulations that no wireless messages could be sent except under certain conditions. In spite, however, of this falling away, the profits had been well maintained in other branches of the business. The company had now 90 ships equipped with its installations—practically every ship on the Australian and New Zealand registers which was suitable for wireless purposes—and its revenue from these ships showed a continuous and gratifying increase. The directors had been endeavouring to secure some additions to their business in order to use their spare working capital, and for that purpose had sent their technical manager (Mr. Fisk) to England and America. Unfortunately, owing to the war, practically all the large electrical, engineering, and motor businesses in Great Britain were engaged in making armament and munitions, and it was found impossible to do anything in the nature of arranging agencies in that connection until the war ended. The board, therefore, were looking round for some other means of utilising the spare capital referred to, and were negotiating for the purchase of certain interests, which they hoped would have the effect of bringing increased returns to the shareholders. Mr. Denison went on to express surprise at the "astounding purchase" proposed by the Minister for the Navy, of the plant, machinery, &c., of the Shaw Maritime Wireless Co. for £57,000. The reason given by the Minister, which Mr. Denison described as "farcical," was that it was needed to make the wireless plant required by the Commonwealth Government for land and marine stations, and to prevent the profit from the same going to foreign manufacturers. Mr. Denison added that the position was briefly as follows:—"Practically all the wireless stations required on the coast of Australia have already been erected, and the whole of the mercantile marine equipped with installations. There is, therefore, little or nothing for such an elaborate plant as this to do in connection with wireless manufacture. Furthermore—with the exception of a very few instruments, the manufacture of which locally would be economically unsound by reason of the cost—all the requisitions of the various shipping companies in Australia and New Zealand, as also those of both Governments, since the war began (excepting for military sets), have been fully met by the supply of apparatus manufactured in Australia and by Australian workmen. The machinery necessary for doing all this work stands in our balance sheet at less than £3,000. Where, therefore, is the necessity of a purchase involving a huge amount such as £57,000? I may say," he said, "that the plant, machinery, and patent rights in question were offered to this company two years ago by Father Shaw, and also by Mr. Whiting (representing Sir Rupert Clark, who is the virtual owner); but after examination by our technical manager (Mr. Fisk) the offer was declined on the ground that it would be impossible to profitably employ such a needlessly expensive plant on wireless manufacture in Australia, and the patents were practically valueless to us."

Dick, Kerr & Co., Ltd.

The profits earned during the year ended June 30th, 1916, were £71,740, plus £18,347 brought forward, making £90,087. After paying debenture interest and trustees' fees, and the sum required to provide for the premium payable on the redemption of the present debenture stock, the balance is £79,297; the preference dividend (6 per cent.) absorbs £18,500, a dividend of 6 per cent. on the ordinary shares will require £15,600; £25,000 is to be set aside to supplement special reserve for contingencies, and the balance of £20,397 is to be carried forward. The directors feel that though it is difficult to foresee the position of the business in the future, they are warranted by the results of the year in recommending the above dividend on the ordinary shares. During the past year, in addition to extensions of contracts for the supply of war material, the Government entrusted the company with the construction, equipment, and management of one of the national factories, which was now approaching full output. During the year control of Messrs. Willans & Robinson, Ltd., has been acquired, and the directors anticipate that this will be of considerable value in the future expansion of business.

Bogotá Telephone Co., Ltd.—The directors report a considerable increase in the number of subscribers connected to the system during the year ended June, 1916. The plant has been maintained in an efficient condition, and the service rendered continues to give every satisfaction. In order to meet the increasing demands for telephone service, the company's premises at Bogotá have been extended so as to provide accommodation for a much larger switching equipment, which is now in course of manufacture.

Parsons Marine Steam Turbine Co., Ltd.—The directors have not been able to complete their accounts for the year ended June 30th, 1916, but they recommend a dividend of 25 per cent. for the year, free of income-tax, of which an interim dividend of 10 per cent. has already been paid, less income-tax.

United River Plate Telephone Co., Ltd.—Interim dividend of 3 per cent. (3s. per share) on the ordinary shares (free of tax), for the half-year ended June 30th.

Dartmoor Electric Supply Co., Ltd.—A petition for reducing the capital from £4,000 to £2,000 is to be heard at Exeter on November 6th.

Callender's Cable & Construction Co., Ltd.—Interim dividend on ordinary shares, 5s. per share, being at the rate of 10 per cent. per annum, less tax.

United River Plate Telephone Co., Ltd.—Interim dividend of 3 per cent. (3s. per share) on the ordinary share capital, free of income tax, for the half-year to June 30th.

Electrical Utilities Corporation, Ltd.—Dividend of 1¾ per cent. on the preferred stock for the quarter to September 30th.

Rio de Janeiro Tramway, Light & Power Co.—Dividend of 1¼ per cent. on the capital stock.

Sao Paulo Tramway, Light & Power Co., Ltd.—Dividend of 2½ per cent. on the issued common stock.

Bell Telephone Co. of Canada.—Quarterly dividend of 2 per cent. for the three months ended Sept. 30th.

Calcutta Tramways Co., Ltd.—Interim dividend on the ordinary shares at the rate of 3 per cent., less tax.

STOCKS AND SHARES.

TUESDAY EVENING.

HEAVINESS has crept into most of the stock Exchange markets. The principal reason given for this, in Stock Exchange circles, is money; in other words, people are looking for higher rates of interest on their investments than they have been content to take hitherto. As we noticed earlier, the issue of the 6 per cent. Exchequer Bonds, coming contemporaneously with the French National Loan, has set up a new standard, which has made it difficult to justify a good many of the prices still current in the markets. Holders of the existing stocks have therefore been trying in many cases to exchange from these latter into some of the newer forms of borrowing; and their efforts to realise such securities have resulted in general depreciation.

When such first-class investments as those in the telegraph and cable market begin to give way, it is obvious that the investor is recasting his ideas as to the interest which his money ought to produce. This is going on in all the markets, and the new loans are taking the money which in the ordinary course of things would have travelled into Stock Exchange directions. Another reason for the hesitation of the investor in employing his present money in stocks and shares is to be found in the answer of the Chancellor of the Exchequer to the question put to him last week with reference to the 4½ per cent. War Loan, when he stated that proprietors of this security would probably have the opportunity to exercise their conversion rights, an announcement which was naturally read as indicating the advent of another popular war loan before long.

Home Railway stocks have suffered severely in the depression. Nearly all the Steam issues are down on the week, and with them have gone the Undergrounds. The only firm spots are the 6 per cent. income bonds of the Underground Electric Railways and the guaranteed stocks of the Central London Railway. The last had their fall just lately, but have steadied at the lower levels. Metropolitans and Districts are decidedly weak. The prior charge lists have once more been revised in the lower direction, Metropolitan preferences again being put down. London Electric debenture and preference stocks are also lower.

The average return on Home Railway debenture stocks is now about 5 per cent. on the money, clear; while the preference issues pay about 5½ per cent. The fact that these are irredeemable scarcely counts for the moment, in view of the competition of the national issues, the cheapness of the latter being obvious, while, in the case of the former, the present buyer will find it necessary to wait for some years before he can hope to see such appreciation as will compensate him for accepting the lower rate of interest, as compared with that offered by our own and the French Governments.

This consideration applies also to the Telegraph market. Jobbers candidly confess that they have sufficient stock on their books, and they are not anxious to load up with any more at present. At the same time, the holders of the stocks are pressing to sell, regardless of the fact that, in the cases of the best-class companies, the dividends are paid free of income-tax and the companies occupy a position of great financial strength. Prices are put down with very little stock changing hands; and the man who wants to buy telegraph issues at the present time may find that he is able to get on even at the lower figure of the two quoted him as the nominal price of the stock.

The weakness has spread to speculative shares, such as Marconis, these having given way 3/16 to 2¾; the market explanation is that shareholders are getting tired of waiting for their expected big dividend and bonus, while the general air of dulness throughout the markets has not been conducive to bullishness over speculative shares. Eastern Extensions and Eastern ordinary stock, both ex dividend, are decidedly lower allowing for the deductions. The only firm spot is Indo-European, buyers having come forward for the shares and raised the price £2 to 51. Henleys weakened to 16¼, and Telegraph Constructions to 39.

In the list of home electricity companies the only change is a slight fall in County of London preference. The ordinary shares, however, retain their rise of last week. The new lighting orders are not expected by the market to have any effect upon the amount of current consumed. There is rather less disposition to buy shares than there has been of late, and the market on the whole is a trifle easier.

Brazil Tractions, after being very flat at 55¼, recovered to 58 on the declaration of the usual quarterly dividends on the shares of the Rio Tramways and the San Paulo Companies. Rumour had been busy in advance with the possibility of these dividends being passed; but this is getting to be such a hoary quarterly that it is surprising to find that it has any effect upon prices. Nevertheless, the Rio Tramways Bonds have been a weak spot—the Seconds in particular. The recent strength of British Columbia electric descriptions has oozed out of their prices; the preference shed 3 points to 72, and some are asking whether the coming report is going to be less good than they had been led to expect a month or so ago. The deferred is also 3 down, and the preferred 4. News from Mexico is not sufficiently definite to tempt enterprise in any of the stocks and shares connected with the country; prices are steady to dull, as they say in the Stock Exchange. Anglo-Argentine Tramways have weakened; the first preference eased off to 3¼ and the 5 per cent. debenture stock, at 72, is 3 points down.

Industrials are disposed to give way. Babcock & Wilcox lost 1/16, going back to the round £3. British Aluminium ordinary shed its rise of last week. General Electrics gave way to 14½. The same tendency is noticeable in most of the varieties connected with industrials. The rubber market has been depressed by reason of the discovery of a law passed in Holland as long ago as last June, whereby excess profits tax is to be levied on the companies operating in Dutch territory. The iron and steel group maintains a fairly firm front, but business on the whole is quiet, and shares in consequence have given way to some extent for the time being. There is a certain amount of disappointment at the way in which developments have shaped in Roumania, and the optimism displayed at the time that Roumania ranged herself upon the side of the Allies apparently led to more buying than the purchasers were justified in undertaking. From the effects of this, together with the monetary position, the markets are suffering now.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Oct. 17, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅞	—	7 1 4
do. do. do. 4½ Pref.	4½	4½	3⅞	—	8 6 4
Chelsea	5	4	3	—	6 13 4
City of London	9	8	12½	—	6 10 8
do. do. 6 per cent. Pref.	6	6	10⅝	—	5 15 8
County of London	7	7	11	—	6 7 3
do. 6 per cent. Pref.	6	6	10½	— ½	5 17 1
Kensington Ordinary	9	7	5⅝	—	6 4 5
London Electric	4	3	1⅝	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4⅞	—	6 11 4
Metropolitan	3½	3	2⅝	— ⅛	5 14 3
do. 4½ per cent. Pref.	4½	4½	3⅛	—	7 4 0
St. James' and Pall Mall	10	8	6⅝	+ ½	6 3 1
South London	5	5	2⅛	—	6 16 1
South Metropolitan Pref.	7	7	1⅝	—	6 7 3
Westminster Ordinary	9	7	6½	—	5 12 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	99	—1	5 19 0
do. Def.	80/-	83/6	28½	— ½	7 10 3
Chile Telephone	8	8	7	—	5 14 5
Cuba Sub. Ord.	5	5	8⅜xd	—	6 3 6
Eastern Extension	7	8	13⅜	—7/-	*5 16 6
Eastern Tel. Ord.	7	8	141½	—1½	*5 13 1
Globe Tel. and T. Ord.	6	7	12½	— ¼	*5 12 0
do. Pref.	6	6	10½	— ¼	5 14 3
Great Northern Tel.	22	22	40	—	5 10 0
Indo-European	13	13	51	+2	6 7 8
Marconi	10	10	2⅞	— 1/16	3 13 9
New York Tel. 4½	4½	4½	100	—	4 10 0
Oriental Telephone Ord.	10	10	2⅝xd	+9d.	4 6 6
United R. Plate Tel.	8	8	6⅞	—	*5 18 5
West India and Pan.	1	—	1	—	—
Western Telegraph	7	8	14½	—	*5 10 4
HOME RAILS.					
Central London, Ord. Assented	4	4	70	—	5 14 4
Metropolitan	1½	1	23	— ¾	4 7 0
do. District	Nil	Nil	17	—1	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	89	+ ½	*6 14 7
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅛	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	3½	— ½	8 9 2
do. 2nd Pref.	5½	5½	2¾	—	—
do. 5 Deb.	5	5	73	—3	6 19 0
Brazil Tractions	4	4	58	+ ¼	6 18 0
Bombay Electric Pref.	6	6	104	—	5 17 3
British Columbia Elec. Rly. Pfce.	5	5	72	—3	6 19 0
do. do. Preferred	—	Nil	57	—4	Nil
do. do. Deferred	—	Nil	56	—3	Nil
do. do. Deb.	4½	4½	69	—	6 3 2
Mexico Trams 5 per cent. Bonds	—	Nil	43	—	Nil
do. 6 per cent. Bonds	—	Nil	85	—	Nil
Mexican Light Common	Nil	Nil	18	—	Nil
do. Pref.	Nil	Nil	33	—	Nil
do. 1st Bonds	Nil	Nil	41	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	3	— 1/16	5 0 0
British Aluminium Ord.	5	7	28/3	— 9d.	5 13 4
British Insulated Ord.	15	17½	13½	—	7 0 0
British Westinghouse Pref.	7½	7½	2⅝	—	6 0 0
Callenders	15	20	19½	—	8 0 0
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	—	8⅜	—	5 6 8
Edison & Swan, £3 paid	Nil	—	10/-	—	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	5	5	62½	—	8 0 0
Electric Construction	6	7½	1/16	—	8 0 0
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	14½	— ¼	6 18 0
Henley	20	25	16½	— ¼	7 13 10
do. 4½ Pref.	4½	4½	4½	—	5 6 0
India-Rubber	10	10	12	—	*8 3 4
Telegraph Con.	20	20	89	— ½	*6 3 6

* Dividends paid free of income-tax.

AIR FILTERS.

[Communicated.]

The importance of thoroughly cleaning the air used for cooling turbo-generators is recognised by all central station engineers, but apart from Mr. Christie's paper, read at the annual convention of the Incorporated Municipal Electrical Association in 1913, little has been published on the subject in this country. Mr. Christie expressed the opinion that cloth filters were very unsuitable for central-station service, as they occupied considerable space, required frequent cleaning, and owing to the combustible nature of the cloths, involved considerable fire risk. His experience with a water spray filter as used in connection with the Plenum ventilating system for large buildings led him to conclude that such an arrangement was far preferable to a cloth filter, for not only is the air thoroughly purified, but it is also cooled. The water spray filter, moreover, is easily cleaned, does not involve the renewal of cloths, offers constant resistance to the passage of the air, involves no fire risk, and in the case of large filters, the space occupied is only one half of that occupied by a cloth filter of equal capacity. The fact remains, however, that a very large number of cloth filters have been installed. One firm, for instance, between the years 1900 and 1909 built no fewer than 1,264 of these filters with an aggregate capacity of 16,100,000 cb. ft. of air per minute. But, of course, the use of wet filters for electrical purposes is a comparatively new idea. The scheme will undoubtedly be extensively adopted in due course, although there are at present a number of engineers who favour cloth filters, mainly because they believe that water spray and other wet filters are liable to charge the air with moisture.

Dry filters are still very popular on the Continent, and various types are in use, most of which have been designed by Germans. These filters usually consist of frames fixed in a suitable structure, and the number of these frames depends upon the quantity of air to be dealt with. Over each frame a cloth pocket is stretched for the purpose of catching the dust and preventing it from entering the generator. Owing to the combustible nature of these pockets, cloth filters should always be placed within brick or concrete walls, and where possible the air should be drawn from outside the building or from somewhere where the atmosphere is reasonably clean. There is no doubt that some dry air filters do involve considerable fire risk, especially when the cloths are dirty. Impregnating the cloths with a view to making them fireproof does not entirely overcome the difficulty, for it has been found that when coated with dirt they will burn more or less freely.

It is to be remembered that the conditions under which these filters operate are very conducive to fire. Large volumes of air are drawn through them, and a spark may easily set the whole filter ablaze. The fire would, of course, be drawn up into the interior of the alternator, where a great deal of damage might be done. Still, it is possible, with certain arrangements, greatly to minimise the fire risk. In some cases a trap-door or damper has been fitted in the air uptake between the filter and the turbo-alternator. Normally this is held open by a fusible metal cord attached to a heavy weight, but in the event of a fire occurring in the filter-chamber, the cord melts and the damper closes under the action of gravity.

Those who condemn the dry filter on the score of fire risk should remember that these filters are not all built on the same principle. Filters with cloth pockets are, it is true, very commonly used in this country, but other types of dry filter are also made. In one case the cotton wool filtering medium is in the form of tubes enclosed in wire gauze, which keeps out flame in the same way as the gauze used on a Davy lamp. So far as the writer is aware, however, this filter has not been tested in any central station in this country, and it is not possible to say anything definite about its performance. The makers claim, however, that the fire risks are insignificant, and that it is superior to pocket filters in other respects. Another dry filter which is claimed to be practically incombustible is made by a French firm. In this case the filter is composed of perforated steel plates, between which cotton wool is placed. But the initial cost of this filter is considerably in excess of that of the ordinary cloth pocket filter, and up to the present it has not made much headway in connection with electrical work. Cotton rope filters are also made. The ropes are mounted in frames in such a way that when the frames are assembled in the filter the spaces between the ropes in one frame are covered by the ropes in the adjacent frame, and it is said that even when the filter is dirty, the resistance offered to the passage of air is slight and the danger of the filtering medium rupturing is avoided. Further, it is claimed that these filters, which are made in vertical and horizontal types, occupy less space than other dry filters. Rupture of the filtering fabric in cloth pocket filters is liable to occur if the filter is too small for its work, for when the cloths get dirty the resistance to the passage of air increases and the air pressure rises. Generally, it is customary to allow an effective area of ·2 sq. ft. for each cubic foot of air dealt with per minute, and the air velocity is in the neighbourhood of 6 to 10 ft. per minute, according to the quantity of dirt that has to be dealt with. With the surrounding air at normal temperature, some 5½ to 7½ cb. ft. of air per KW. must be forced through the windings of the machines every minute. It is pretty well agreed by those who have had experience with cloth-pocket filters that the work of cleaning them is not, on the whole, a congenial form of occupation. Some advocate chemical cleaning, but the experience of most engineers is that the process destroys the filtering properties of the cloths, and, further, that the pockets shrink. The most common and the most satisfactory method of cleaning is to use a vacuum cleaner. The air resistance offered by pocket filters after cleaning is always higher than the resistance offered after a previous cleaning, and it is therefore necessary, quite apart from the cloths wearing out, occasionally to renew some of the pockets, so as to keep the resistance within permissible limits.

As regards wet filters, a type that has recently made considerable headway in this country, and which undoubtedly gives excellent results, is the Heenan wet-surface filter. As is well known, the air in this case passes over large wet surfaces. Thin galvanised plates are wound on a cast-iron centre, and between each layer a space of about one-sixteenth of an inch is left for the air to pass through. The lower part of the drum revolves in water, and the air passes through the upper part. In the opinion of the writer this type of filter requires a lot of beating. It not only effectively cleans the air, but it also cools it, and there seems to be no doubt that the air leaves the filter entirely free from loose moisture. The plates are revolved in the water at a low speed by a small motor geared to the shaft, and the amount of power required for driving the drum is not by any means a serious item. Within the last few years a considerable number of these filters have been erected in central stations, especially in stations where large sets are in use. Filters of the type used by Mr. Christie are generally known as air washers. Many kinds of these filters or washers are now built, but the fundamental principle is the same in each case. The air is brought into contact with the water in the form of spray or mist, with the result that any dirt that may be present in the air is saturated with water, and its weight increases. On its way to the generator the air passes through baffle or eliminator plates, but the water and particles of dirt having greater weight than the air, strike these plates, and are washed down into a settling tank.

The air leaves the washer clean and free from unevaporated moisture. Moreover, the temperature of the air is reduced. In the case of Mr. Christie's air washer the water screen, which consists of a series of small nozzles spaced 6 in. apart over the entire area of the filter, is placed about 2 ft. inside the air inlet, and at about 6 ft. beyond the screen the baffles are fixed. The base of the filter chamber forms a fresh water tank, which holds about 300 gallons, and is fitted with a ball cock to keep the level constant, and so compensate for evaporation. A 2-H.P. motor-driven centrifugal pump circulates the water at a pressure of about 25 lb. per sq. in. through the nozzles which project it in the form of a finely atomised spray directly against the incoming air. All solid matter in the

air is caught by the baffles and precipitated in the tank. Any beads of moisture or grit carried through with the air are effectively trapped by the baffles, and nothing but pure cool air is carried into the machine. During the winter it may be necessary in certain localities to fit a small steam coil in the water tank, otherwise the water may freeze.

It has been suggested on several occasions that if a refrigerator were used to cool the ventilating air considerable overloads might be carried by the generators, but so far no one seems to have adopted this plan. The idea has been more seriously considered since the introduction of wet filters into central-stations, which is attributable to the fact that experience with these filters has shown that cool air gives a distinct advantage in the way of overloads. It is clear, however, that the type of filter does not in any way determine whether the refrigerator scheme is practicable. Dry filters could be used in conjunction with a refrigerating plant just as well as wet filters, but whether the additional cost and complication can be adequately compensated by the additional load that can be got out of the machine remains to be demonstrated. It is to be distinctly understood that the main function of all filters is to cleanse the air, and that the cooling effect of wet filters is only incidental. In tropical climates the cooling effect due to these filters may be very appreciable, but in normal climates the advantage may be much less marked: hence it is inexpedient to increase the rating of a generator, because it is to be worked in conjunction with a wet filter. An accident—a breakdown of the circulating pump for example—may put the filter out of action, and the same applies, of course, to refrigerating plants. The additional load permissible with the cool air could no longer be carried, and in the absence of reserve plant, difficulty might arise. It has been found that if the same water is circulated through an air washer, and only enough added to compensate for evaporation, the temperature of the water and air mingled with it will be within a few degrees of the wet-bulb temperature of the air; but if the whole of the water is continually renewed, the air can be cooled to the temperature of the water, and where water is plentiful, the latter scheme may possibly be adopted with advantage.

There are, as already stated, many types of air washers on the market, especially in America; but the fundamental principle is the same in each case. The variations in the different types are confined mainly to the design and arrangement of the nozzles. Into the details of the various types of washers it is unnecessary to enter, for information of this kind can be derived from the manufacturers' catalogues. What is more important to central-station engineers at the present time is a consideration of the merits and demerits of the wet and dry types. Some of the wet filters now at work in central stations were not originally designed for this class of service at all, but for use in connection with the ventilation of large public and other buildings, textile mills and factories. Practically all central station engineers who have adopted them praise the simple way in which they can be cleaned. In this respect all wet filters are undoubtedly far superior to dry filters, and, quite apart from any other advantages which wet filters offer, this feature is a decided boon. Cloth filters are often much more easily cleaned in the summer than in the winter. When the weather is dry the dirt may be removed by beating or with a vacuum cleaner, but in some places it has been found that when the weather is wet or damp the cloths are very difficult to clean indeed. The cloth pockets absorb the dirt to such an extent that after a short time it is necessary to scrap them. Everything seems to indicate that sooner or later the orthodox pocket filter commonly adopted in this country will be replaced by wet filters of some kind, unless, of course, it can be shown that some of the comparatively new dry filters mentioned are distinctly superior to those commonly employed. For small sets it is possible that dry filters may continue to be used, but in large stations wet filters are rapidly being adopted. Whether the wet surface filter will meet with greater favour than air washers remains to be seen. Both have given very satisfactory results wherever they have been tried, although, so far, wet surface filters have been more extensively used in this country than abroad. In America they use spray and dry filters, whilst on the Continent wet filters of any kind have not, up to the present, made any appreciable headway. Some American power houses, the power house of the Detroit Edison Co., for instance, have air washers placed on the roof, and air is drawn through the washers into the turbine room by means of a fan. The turbine room is thus supplied with cool, clean air, and all parts of the plant are, as a result of this arrangement, kept, comparatively speaking, clean. On leaving the washer, however, the air is heated by passing it over warm surfaces to ensure that when it comes in contact with the machine windings, it is quite dry. Cooling effects are, therefore, not obtained, but the power house has the benefit of clean and moderately cool air.

The cooling effect that has been obtained with wet filters installed in generating stations in this country has led to an interesting suggestion, namely, that electrical thermometers might replace ammeters for determining the permissible output of electrical machines. Since the load which an alternator can safely carry is determined by the permissible temperature rise, this appears to be a good idea. But the main drawback to the scheme is that it is very difficult to get the temperature of all parts of a generator. Unfortunately, it is possible for an alternator to have hot spots, and unless the temperature is measured at these places trouble is liable to arise. Some day this scheme of measuring the temperature of the windings instead of measuring the current may be adopted, but until a satisfactory method is found of arriving at the maximum temperature, it is, in the opinion of the writer, unwise to depart from the practice of basing the safe output of a generator on the actual current it supplies.

ELECTRICITY IN THE SPELTER INDUSTRY.

At the recent meeting of the Institute of Metals, the subject of the extraction of zinc from the ore and its subsequent refinement, by various methods, received attention. We abstract the following references to electrical methods from a paper by Mr. Ernest A. Smith, A.R.S.M.

In the treatment of zinc-bearing complex ores, development has been rapid in recent years; mechanical dressing and magnetic and flotation processes of concentration have done much towards solving the problem. Much progress has been made in magnetic separation, and many machines have been introduced. Electrostatic methods for the separation, by electric repulsion, of good conductors (such as certain metallic sulphides, magnetite, and hematite, &c.) from poor conductors (such as silicates, carbonates, oxides, and sulphates, including zinc blende) have been applied in practice by several inventors. Huff discarded the electrostatic generator of the Wimshurst type, and employs a dynamo current of suitable intensity. The separator is thus capable of adjustment to any required strength of electrical field, and is less liable to interference from climatic conditions. Magnetic separation of blende and pyrite may be accomplished without preliminary roasting by the use of high-intensity magnetic separators of the Wetherill type, the zinc mineral being lifted out of the mass. The more usual practice, however, is to give the mineral a magnetic or "flash" roast, rendering the iron magnetic, after which it is separated from the mass by separators of the low-intensity type, such as the Dings. The limiting factor of electric separators appears to be their inability to handle fine powders, and their liability to dust trouble, unless the dust be first removed.

In 1901 C. P. G. de Laval erected the first electric zinc-smelting furnace on a commercial scale, and four years later works were erected in Scandinavia to carry out his process. Since that time a considerable amount of attention has been given to electric furnaces for smelting zinc ores.

The electric furnace is not intended to replace the retort furnaces in the smelting of zinc ores, but to be used for the treatment of ores not suitable for the distillation process, or possibly as a substitute in localities where fuel is dear but hydro-electric power easily available. Early experimental work by W. R. Ingalls, at McGill University, confirmed the opinion that, if electric smelting is to offer any advantages, the process must be continuous, and all modern furnaces are constructed on this principle. In many of the electric furnaces now in use the energy is applied with great ingenuity and high efficiency is obtained, whilst efforts are made to reduce the electrode consumption to a minimum. The reduction in the electric furnace appears to take place more rapidly than in retort smelting, but the reaction between the carbon and carbon dioxide does not appear to occur to such an extent as in the retort. Hence the electric furnace contains an atmosphere comparatively rich in carbon dioxide, so that a

larger amount of fume (blue powder) is formed than when the retort furnace is employed.

While progress has been made, the discovery of some means of avoiding oxidation of the zinc deposits, as formed under the conditions prevailing in electric smelting, is still the problem which metallurgists have to solve in connection with this method.

The continuity of operation in the electric furnace appears to imply discharging the residue as a slag that will run, and there has consequently been a tendency for inventors of electric zinc furnaces to render the charge fusible, so that fluid slags may be tapped as from cupolas. This condition, however, prohibits any great excess of carbonaceous material in the charge, and accounts for the higher percentage of carbon dioxide frequently found in continuously operated furnaces.

The de Laval process, carried on at Trollhättan, in Sweden, develops heat by means of the arc, current being generated from water-power at prices variously given as from 38s. to 50s. per electrical H.P.-year. The works are equipped for 15,000 H.P. The furnaces are of the resistance type, with one large vertical carbon electrode passing through the roof, the other electrode being a carbon block in the bottom of the furnace. Each furnace has a capacity of about 3 metric tons, and smelts nearly 3 tons of ore in 24 hours.

The complex ore is roasted to about 7 per cent. to 8 per cent. sulphur, mixed with anthracite or coke and flux, and charged through a hopper into a closed "melting" furnace, where most of the zinc and some of the lead are volatilised, and condense chiefly as crude spelter high in lead, and partly as blue powder, which has to be re-treated. The other part of the lead is reduced to metal and is tapped out with the slag. It contains a considerable proportion of the silver. Some matte is formed, and this and the slag contain some of the lead, zinc, and silver. The crude leady spelter passes to the refining furnace, where the zinc is distilled, producing, on condensation, spelter of high purity and a further quantity of zinc dust, leaving the balance of lead and silver as base bullion. Two melting furnaces supply one refining furnace. The company owning these Scandinavian works reported recently that its smelting operations have not yet proved commercially profitable; considerable progress has, however, been made, and it is hoped that things will eventually turn out well.

The Cote and Pierron process is carried on, on a small scale, at Pau, in France; experimental work was also carried on in 1914 at Ugine, in Savoy, and Quenean, in Belgium. An important feature of the process is the smelting of blende in the raw state. Whilst simplifying the metallurgy of the process, this method increases the difficulties of operation of the electric furnace. "The process* is based on the fact that iron replaces lead in lead sulphides at a comparatively low temperature, and zinc in zinc sulphide when the temperature is increased. It is claimed for the process that by its means zinc and lead can be completely separated. The furnace is circular, with sides and bottom lined with graphite, the top being a low dome of fire-brick. A carbon electrode, which can be raised or lowered, passes through an opening in the centre of the top, the other electrode, a cone of graphite, projects from the hearth. The furnace is charged through the roof, and the lead, slag, and iron sulphide are tapped through an aperture in the side. The volatilised zinc passes through an outlet in the upper part of the furnace to the condenser, which consists of a cylindrical shaft-like chamber of fire-brick filled with coke or anthracite, and provided with a taphole at its base for the discharge of the condensed zinc."

The charge, consisting of a mixture of blende, iron, and lime, is introduced into the hot furnace, and the first reaction of iron on lead sulphide is effected at a relatively low temperature. The resulting lead is then tapped. The temperature is then raised and the decomposition of the zinc sulphide by the iron brought about. The zinc distils over, and is condensed in the condenser, the carbon in which is kept at a red heat, to diminish, as far as possible, the formation of zinc fume. Finally, iron sulphide and the slag are run out.

In America considerable experimental work has been done with Johnson's electric furnace at Hartford, Conn., and it is stated that arrangements have been made to erect a 100-ton commercial plant at Keokuk, Iowa. This is a continuous process, with furnace of the resistance type, in which the charge carries the current. The charge is heated to about 900 deg. C. in a continuous pre-heater before reaching the furnace. To prevent the formation of blue powder, the carbon dioxide formed in the smelting zone is rendered innocuous by passing the gases from the furnace through an electrically-heated carbon filter, whereby the carbon dioxide is converted into harmless monoxide.

Electric zinc smelting has now passed the mere experimental stage and become a commercial process. It is not correct, however, to say that it has emerged altogether from the experimental stage, since it is being continually experimented upon by those interested in this method of smelting zinc ores.

Recently hydro-metallurgical processes have been devised in which the zinc, after having been obtained in solution, is precipitated in the metallic state by electrolysis. Electrolytes of zinc chloride solution are said to be more economical in electric current than solutions of zinc sulphate, the electromotive force necessary for the decomposition of the former being less than for the latter.

The Nahnsen process has been employed at Lipine, Silesia, from 1893 till the present day, the electrolyte used being a solution of the double sulphate of zinc and magnesium. The Hoepfner process has been commercially successful in Germany, Austria, and England. A modification of the process is in use at the works of Brunner, Mond & Co., near Northwich, Cheshire, for the production of a fine zinc which is now made in considerable quantities for the manufacture of brass for cartridge cases and other articles requiring a highly ductile alloy.

The zinc ores are leached with waste calcium chloride in the presence of carbon dioxide; the resulting zinc chloride solution on electrolysis gives a zinc of 99.96 per cent. purity (known as Mond zinc), and chlorine gas, which is used in making bleaching powder. The anodes are of lead or carbon, and the kathodes rotating disks of zinc, partly immersed in the electrolyte. The intensity of the current is 100 amp. for 10.8 sq. ft., with an electromotive force of 3.3 to 3.8 volts.

The Hoepfner process is in operation at Duisburg, Germany. Two plants were also erected in 1914 at Kristiania and Balestrand (Norway) for the treatment of Broken Hill flotation concentrates.

The Dieffenbach process is applied to Westphalian iron pyrites containing 8 per cent. of zinc, which is extracted by a chloridising roast of the crushed ore, following by leaching with plain water. The residue, which is said to contain only 0.5 per cent. zinc, is smelted for iron, whilst the aqueous solution of zinc chloride is electrolysed in double-compartment vats, the anode compartment being completely closed. The liberated chlorine is employed in the manufacture of bleaching powder.

The processes which are being tested in American plants are based on sulphuric acid leaching and subsequent electrolysis of the zinc solution, using lead anodes. The well-known Anaconda Copper Co. is now completing a 25-ton plant in which flotation zinc concentrates, after a sulphate roasting, will be leached, with barely sufficient acid to extract the zinc, the resulting liquor being purified by the addition of zinc oxide. This plant when completed will, it is stated, produce some 35,000 tons of fine zinc per annum.

At the Bully Hill mine (Shasta co., Cal.) the zinc sulphate liquor is precipitated with lime, and the precipitate of zinc hydroxide and calcium sulphate is suspended in the electrolyte to neutralise the acid as fast as it is formed. For the same purpose the Reed Zinc Co. (Palo Alto, Cal.), in the recovery of zinc from bag-house dust, use a spongy lead anode, which is converted into sulphate. By reversing the current, sulphuric acid and lead are regenerated.

At Silverton, B.C., the ore is leached with bisulphate of soda and electrolysis carried out, with the addition of manganese sulphate. The anode becomes coated with manganese dioxide, which is redissolved and used over again.

In view of the increasing demand for electrolytic zinc, hydro-metallurgical methods of extraction are receiving renewed attention.

In a note on "Cadmium in Spelter," Mr. W. R. Ingalls remarked that the electrolytic process of zinc extraction afforded an easy means for the separation of cadmium. It should be borne distinctly in mind that the electrolytic process was going to be commercially applicable only under some limited specially favourable conditions, and was not going to drive zinc smelting out of the world's arts. However, the electrolytic zinc production that was likely to endure should go a long way toward meeting the demand for high-grade spelter, and especially spelter low in cadmium. Furthermore, inasmuch as the electrolytic kathodes had to be remelted in large furnaces, the slabs cast therefrom should be more uniform in composition than those coming from the small tapping kettles of the retort furnace.

* Gowland, *Metallurgy*.

INDUSTRIAL ECONOMIES.

In the course of his presidential address to the Birmingham Association of Mechanical Engineers, on October 17th, Mr. R. A. Chattock said that the enormously increased outputs and altered conditions of working that had been imposed upon the engineering industry would undoubtedly have a great effect in establishing a new condition of affairs in engineering after the war was over. There would probably be a large amount of industrial disorganisation when the present enormous production of munitions of war ceased, but he did not think it would be of any great duration, because it was evident on all sides that it was the intention of British manufacturers to develop the trade of the country on much better lines than formerly. They ought to take the fullest advantage of any economies that were pointed out to them by scientific research, and ought themselves to inaugurate research of this character, in order to equip themselves to meet the keen competition that was bound to come.

Research work was very expensive work; industrial combinations would be very useful by enabling groups of manufacturers to obtain valuable results for the conduct of their businesses. It would be the wrong policy for a great number of research laboratories to be installed; central research

laboratories should be established, each dealing with some special branch of the manufacturing industry, where the best brains available for the purpose could be concentrated. Most likely these laboratories would have to be placed under Government control, but they should be maintained by the firms interested in the results to be obtained from them, possibly by some form of annual contribution proportionate to the turnover of such firms.

During the present shortage of men, women had been employed to a large extent in engineering works; whilst a certain number of these might remain, he did not think that this would be so to any very great extent.

The high wages ruling at present in engineering works would probably continue to a large extent, and he did not see any objection to this if the workmen would do good work for the money they received. Unfortunately, in the past, many workmen had seemed to strive to do as little as they could for what they earned, and if this spirit were allowed to continue there was no doubt that effective competition with foreign countries, where such conditions did not obtain, would be almost impossible.

In addition to this, manufacturers must exercise greater economy in their methods of production. Perhaps the most important economy that could be effected was in connection with the supply of power required to drive their works.

In a report of the Royal Commission on Coal Supplies in 1905, an average figure of 5 lb. of coal per H.P.-hour was given as being the consumption obtained by industrial concerns in connection with the production of their own power. In the most modern electric power stations this figure could be reduced by about one half. An economy of 50 per cent. in the coal used for driving our manufactories should fully justify strong measures being taken to make it obligatory upon manufacturers not to waste coal in the way that had been going on to a large extent up to the present. A Committee of the British Association had been appointed to report upon this particular question, both with a view to economising the use of fuel and for the prevention of smoke. The deliberations of this Committee indicated that the greatest economy in the use of coal could be obtained by gasifying it and recovering its valuable by-products. This must be done on an enormous scale to be really effective. It was impossible for individual manufacturers to do this with anything like the economy that could be obtained if the whole of the coal used in the country were so treated at certain convenient centres. The number of processes involved was very considerable, and the handling of each by-product would practically be a business in itself. The capital cost involved would be heavy, and could only be made remunerative by working the process on a very large scale. He thought, however, that, if only for the proper conservation of the available coal supplies in the country, such a scheme should be developed.

The transformation of the energy in the coal into electrical energy was the one link that rendered a scheme of this kind possible, because if all the coal consumed in the country were so treated at certain centres, the energy produced would have to be transmitted all over the country for use wherever it was required. The only way of doing this with a reasonable capital expenditure was electrically.

The plants would have to be installed as near to the great coal centres as possible, having due regard to a sufficient supply of water being available for condensing purposes. This was a very important consideration, and might necessitate placing them within reach of the sea or on tidal rivers. If cooling towers were used, roughly 3,000,000 gallons of water per day were evaporated per 100,000 KW. of plant installed, so that a station of 800,000 KW. would evaporate all the water that came into Birmingham from Wales each day if it could be made available. From this it was evident that an inexhaustible supply of water was a prime necessity.

A commencement had already been made in this direction. In Yorkshire coal was being gasified at the pit; the gas was being used for firing steam boilers and producing electrical energy; sulphate of ammonia was being recovered, and coke was being produced. The Corporation of Brighton was considering a somewhat similar scheme, although in this case the by-products were to be handled by a company which was proposing to sell the gas to the Corporation for use in its generating station.

Energy in an electrical form could be economically transmitted at high pressure over very great distances by means of overhead trunk lines, transformed to a lower pressure, and distributed wherever required. It must not be forgotten that electrical energy could now be efficiently applied to practically all purposes for which coal was used.

If, therefore, energy could be produced and transmitted in this way at a figure that compared favourably with what it at present cost the consumer to supply himself, the justification for such a scheme was fully made out.

Experience in the past had shown that large modern generating stations employing the most economical apparatus obtainable had been able to supply electrical energy at a figure considerably below what obtained ten years ago, and one that was still being reduced from year to year as the stations continued to grow, and as the load factor of the stations increased. The largest stations in this country had approximately 100,000 KW. of plant installed in each. If stations were to be built to supply electrical energy for practically all purposes for which coal was now being used, they would require to be probably five times this size, or, say, 500,000 KW. capacity of plant installed. In stations of this size it would be quite possible to arrange for some of the boilers to be fired by means of gas, and for others to be fired by coke or other form of fuel produced from the distillation of the coal. At the same time, the valuable by-products in the coal could be recovered and disposed of, thus reducing the cost of the supply of electrical energy to the consumers.

A scheme of this kind would lend itself admirably to the utilisation of the poorer quality coals which in normal times it hardly paid to work. In the report of the Royal Commission on Coal Supplies referred to above, it was estimated that this unworkable coal amounted to about 25 per cent. of the total coal raised from the pits. If such an enormous quantity could be beneficially utilised for the production of electrical energy instead of being wasted as at present, that alone should go far to justify the adoption of a scheme such as the author had outlined.

Coal could be gasified in two ways—either by high-temperature or low-temperature distillation. High-temperature distillation was used for the production of ordinary town gas, and certain by-products were obtained such as coke, coal, tar, &c. A number of products were, however, destroyed in this process.

Low-temperature distillation produced a form of smokeless fuel, different to coke in that it would burn in an open fire grate. In addition to this, a number of other valuable by-products were produced. In order, however, to obtain the same amount of heat energy in the form of gas by this process, a very much larger quantity of coal had to be treated. Something like six to eight times the weight of coal had to be handled to produce a fixed quantity of electrical energy as would have to be handled if the coal were burned to destruction in the boiler fires. This pointed to the necessity for converting the heat units in the gas, and in the coke or other fuel produced as well, into electrical energy, otherwise there would probably be difficulty in disposing of all the fuel on the outside market.

A scheme of this kind would occupy an enormously greater area of ground than the ordinary electric generating station. The production of electrical energy from a scheme such as he had outlined, at a cost far below what obtained at the present time, would make it possible for all users of coal to use electrical energy economically in substitution therefor. Owing, however, to the conservative nature of the average man, it was very doubtful whether such a change could be brought about quickly enough to justify the erection of these larger super-stations, and to make them pay for themselves within a reasonable time, without some special steps being taken for the purpose.

The very slow development of the electric supply business that had gone on in the past in this country did not hold out much hope of any real progress being made by natural development, and in order that the public might obtain quickly the benefits that would be afforded by such a scheme, it would appear that some form of compulsion should be exercised in bringing it about. Such a course would, in Mr. Chattock's opinion, be fully justified, having regard to the national importance of the results that would be obtained:—

1. By the proper conservation of the coal supply of the country.
2. By the elimination of smoke from our atmosphere.
3. By the possibility of giving a supply of power to manufacturers and other users at a figure so low that it would represent a saving in their cost of production, and consequently a most valuable asset to the commercial prosperity of the country, and a weapon to fight foreign competition.
4. By relieving the congestion on the railways owing to the reduced traffic of coal which at present had to be delivered all over the country, and under this scheme would only have to be delivered by special lines to certain fixed centres.

Compulsion could be exercised directly by Government control of the coal supply of the country, or indirectly by putting a tax upon all users of coal who consumed it in an uneconomical manner. Such a tax should be utilised for financing a scheme of the kind indicated until it became self-supporting.

In pressing for the adoption of this method, by which such an enormous economy could be effected, he knew that there was bound to be very serious opposition from many existing interests; it was obviously impossible to inaugurate such a change without interfering to perhaps a large extent with those interests, but if the great benefits to be derived from it were proved by searching inquiry to be obtainable, then, in his opinion, the Government ought to take the matter up and deal with it in the national interests. Now was the time to act if they were to place British industries upon a basis firm enough to meet successfully all foreign competition.

ENGINEERING APPRENTICESHIP.

For the subject of his presidential address to the Association of Supervising Electricians, on September 26th, Mr. A. P. Trotter took up the system of apprenticeship for the electrical trade. After pointing out the distinction between "education" and "technical training" for the purpose of making a lad a skilled workman, he referred to the extreme

subdivision of trades under modern conditions, which tended to make every skilled workman a specialist. The introduction of machinery into the textile industry was one of the causes of the break-up of the old apprentice system, and the loss of the personal element in the modern business firm put an end to the direct relationship that formerly obtained between master and apprentice, thus rendering it uncertain who should undertake the important duty of teaching. Employers should consider whether it was worth their while to take such steps, both during the ordinary working hours of apprentices, and by allowing them to attend trade classes, to secure young men trained to do good and intelligent work in the style of the firm, and well versed with its special lines. Apprenticeship would secure these. The inevitable wasters would drift in, but a probationary period of not less than one month, but not more than six, would give them the opportunity of drifting out again.

Evening classes relating to the work on which a lad had been engaged all day were not desirable. They had their uses in certain cases. They required not only grit, but a good physique. They were a valuable means of improving and widening the knowledge of those who had not had the benefit of a regular apprenticeship, or who had an ambition to rise higher in their trade, or to follow some other branches of their daily occupation.

The apprentice should be bound to attend, and the employer should see that he did attend, the chosen trade or handicraft day classes (without loss of wages), for periods of at least two or three hours per week, or two mornings or afternoons every week, thus making a minimum of six hours' weekly instruction in the theory and practice of his trade. For technical classes to be successful, it was desirable that the teaching should be in close touch with the trade, and employers should be invited to take an active interest in the scope and method of the training.

This instruction should not be a mere extension of the daily work, carried on under the supervision of a teacher, but in the case of most trades it ought to consist of a study of general or scientific principles, illustrated or demonstrated by examples taken from the practice of the daily work.

In a science class a teacher avoided spoon-feeding, because he was using science for an educational purpose, and wished his students to think out problems for themselves. He illustrated general principles and theories which constituted any particular science by experiment. In a trade class much of this was reversed. The experiment, whether the tinning of a soldering iron, or the charging of an accumulator, was the starting point, the main thing to be understood, and the principles and theories were brought in to explain it. The importance of systematic work should be taught. One man would fumble for an hour or more with a detector, sorting out circuits in a tangle of wires; another would finish them off in a few minutes because he worked on a method.

Mathematics were absolutely essential for the higher branches of electrical engineering, and in the more simple departments, such as fault localisation, mathematics enabled a trained man to take wonderfully short cuts. But a thorough grasp of the subject from a common-sense point of view would often enable a plain man to "get there."

An apprentice should come so grounded in simple arithmetic that he should not have to be taught it, but only have to exercise his knowledge of it in the trade classes.

The demand for trade classes in any special subject must precede the supply. The City Guilds had done a great deal for higher scientific teaching; it would be appropriate that help should come from this quarter to revive apprenticeship, which was originally instituted as the carefully guarded entrance to the Guilds, and that they should aid in the development of the guild spirit—a pride in craftsmanship of the highest quality. Courses of instruction were already provided in London by the London County Council at day schools, to a greater extent than was generally known; and since these were by no means centralised, but were widely distributed, they could be carried on in the same way not only in other cities, but in the smaller towns.

Seeing that the London County Council was prepared to provide trade classes for apprentices, and that it controlled or was in touch with a large number of polytechnics and technical institutes, no special organisation of the electrical trade seemed necessary. It only remained for firms to put themselves in touch with the facilities which already existed.

The main advantage to the electrical engineering industry in encouraging the apprenticeship system was that it secured good workmen thoroughly instructed in the craft. In the case of electrical contractors engaged in wiring, sound workmanship became a matter of public importance. Ironmongers and decorators, who had succeeded in putting up electric bells, had gone on to try their hands at wiring for electric light, with disastrous results.

The old period of apprenticeship of seven years was too long in these days of competition and higher pressure. An apprentice who received sound training in trade classes, and thus learnt to understand his work intelligently, would master it sooner than a boy coming straight from an elementary school to pick up a trade by simply working at it. The period of modern apprenticeship should not exceed five years, and in some cases of simple repetition work, might be reduced to three. In general four years seemed to be a suitable period for electrical contractors. If there was a variety of work, the apprentice might not have a chance of seeing it all during a period of less than four years.

Mr. Trotter deprecated the payment of a premium. In the absence of a premium, relations became simplified, a small wage was paid, and this placed the master in his proper position.

He recommended those who wished to receive apprentices, or to obtain more information on the subject, to communicate with the Secretary of The National Institution of Apprenticeship, 28, York Place, Baker Street, London, W. It had arranged apprenticeships in 81 cases for electrical fittings makers, electrical fitters and turners, electrical instrument makers, electrical brass workers, and armature and coil winders, and in 142 cases for general electrical engineers.

There was another institution, The Apprenticeship and Skilled Employment Association, with an office at 53, Denison House, Vauxhall Bridge Road, London, S.W., with a considerable number of affiliated local committees.

INDUSTRIAL ELECTRIC HEATING.

In a paper read recently before the National Electric Light Association, by Mr. E. F. Collins, the author discusses the progress made in industrial electric heating in recent times and the advantages, in improved quality of product and, in many cases, decreased cost, which have resulted; his remarks in abstract are as follows:—

A decision as to whether electric heat may be employed to replace other means of heating cannot safely be determined by comparison, simply on a B.Th.U. basis of cost of electric heat as against heat for fuel. The heating engineer must consider the advantages: control of temperature, ease and directness of application, increase of production, reduction in fire risks, decrease of labour of attendance, decreased cost of up-keep, freedom from smoke, gases, and excessive heat lost to the room creating discomfort to the operators in hot weather, saving in floor space, increased quality of production, and saving of lost heat due to fuel being burned uneconomically through the carelessness of operators in adjusting fires, burners, &c. A kilowatt-hour in an electric heater must create 3,412 B.Th.U.; on the other hand, the writer has seen cases where the operator used double the fuel oil that was required for certain heating, simply because he did not have the skill or care to adjust his mixtures at the burner for perfect combustion.

It is intended in this paper to deal only with the application of electric heat in industrial processes that require 950° F. or less. Three general types of heating units have been developed by the manufacturer to cover industrial heating devices not requiring more than 950° F. These units are the air heater unit, the hot-plate or cast-in or embedded unit, and the immersion type unit. These units are generally of the metallic resistance type, this resistance being of the nickel-chrome combination, which is free from corrosion in the air at temperatures much in excess of their normal operating temperatures. These units are designed so that they may be used singly or in combination to take care of standard voltage such as 550, 440, 200, 110 alternating or direct current.

The air-heater type of unit consists in general of a framework of steel or cast iron carrying insulators made from mineral compounds such that they afford high insulation resistance even at the fusing point of the metallic resistance which they carry. This resistance, in the best designs, is of the nickel-chrome-type alloy, and is non-corrodible in air at a temperature of 800° C. or higher. Where a number of these heaters are connected together in air, an oven, or other heating chamber, it has been found best to use steel bus-bars and connections mounted upon insulators having the same characteristics as the heater insulators. In addition to high insulation and refractoriness at high temperatures, this compound has practically no expansion and contraction, and is not affected by moisture even at high temperature.

Air heaters have a very wide application. When used in heating ovens, they are usually units of capacity ranging from 3 to 10 kw., which may be distributed to give uniform heating results and the desired oven temperature. Standard control panels both for hand and automatic control through the medium of an oven thermostat are available, and are, in fact, a necessity for most installations.

The hot-plate cast-in, or embedded type of unit, consists generally of a metallic resistance properly insulated and clamped between metal plates, or it may have the resistance wire suitably insulated and cast in a metal plate or container as an integral part of such, or the same type of wire may be embedded by rolling, swaging, welding or other method in metal plates or other carrying parts. Such units are usually employed by clamping them in contact with the parts to be heated, and are suitably lagged to prevent loss of heat from external surfaces in contact with the room. These units are likewise designed for use in standard voltage circuits, either individually or in combination, and in many cases are wound to give three heats through the use of a three-point snap-switch.

The immersion type of unit is, in general, of such form that the resistance itself may be immersed in the body of fluid it is to heat, or it may be protected from direct contact with the fluid by an intervening insulated and protecting sheath. One end of the sheath protrudes from the fluid, and carries the heater terminals. In the application of the immersion heater to industrial uses, the writer favours automatic regulation of temperatures, and to this end recommends the use of a thermostat and automatic switch to control and prevent overheating, and yet allow the most rapid heating.

The following table shows some of the more common industrial applications of the foregoing heating units and the particular type of unit usually employed :—

Process of device.	Temp. range, deg. F.	Type of heating unit.	Method of heat control.
Baking of japan ..	300-600	Air	Hand or automatic
Baking of varnish and paints..	100-300	,,	Automatic,
Baking colour enamels	100-300	,,	,,
Baking bread & pastry	150-600	,,	,,
Baking foundry cores	350-500	,,	,,
Baking insulations ..	200-500	,,	,,
Annealing copper ..	350-700	,,	,,
Annealing aluminium	500-800	,,	,,
Annealing glass ...	900-1,000	,,	,,
Tempering steel ...	200-1,000	Air and hot plate	,,
Melting lead	620-700	,, ,, ,,	,,
Melting tin	450-500	,, ,, ,,	,,
Melting babbitt	450-700	,, ,, ,,	,,
Wax and compounds	150-500	Air, plate and immersion	,,
Heating coils	100-1,000	Plate and immersion	,,
Heating water.. ..	32-212	Air, plate and immersion	Hand or automatic
Making steam.. ..	212-500	Air and immersion	Automatic
Heating metal moulds	200-1,000	Air and plate	Hand or automatic
Lumber drying kilns .	100-200	Air	Automatic
Boiling varnishes ..	100 (?) 500	,,	Hand or automatic
Heating buildings ...	0-80	,,	Hand
Soldering	400-650	Plate	,,
Glue pots	100-200	Cartridge	Hand or automatic
Melting type metal, linotype machines...	625-700	,,	,, ,, ,,
Sherardising	650-700	,,	Hand

Those heating processes employing the air heater have, during the past two years, yielded the central stations a large KW.-hour output. Very great success has attended the use of the air heater in baking-ovens whose temperatures range from 300 to 500° F. A specific use is that of japan baking. It may be said that already more than 40,000 KW. of connected load in air heaters has been installed for this purpose. The writer does not know of a single installation changed to electric heat which has not been so satisfactory that it has worked to extend the use of electric heat for baking purposes.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

FRANCE AND ALGERIA.—In reference to the issue, by the new French Customs Office in London, of licences authorising the importation into France and Algeria of goods of British manufacture which are included in the list of articles prohibited to be imported into those countries, it is pointed out by the Board of Trade that it would prevent delay in the issue of the licences if British firms would specify in their applications the value of the goods (expressed in English currency), and the weight of the packages in kilogrammes (kilogramme = 2.2046 lb.), as well as in English units. Exporters desiring to obtain licences should apply to the French Customs Office, King's House, Kingsway, W.C. Forms of application may be written, typed, or printed, so long as they are strictly in accordance with the model printed in the *Board of Trade Journal* of September 7th.

FRANCE.—A Presidential Decree prohibits as from September 17th the exportation and re-exportation of electrical material suitable for use in war, and any detached parts thereof.

GERMAN NEW GUINEA.—A new Customs tariff has been issued by the Administrator under the British Military Administration, with effect from May 18th last. All goods not specifically tariffed and not included in the free list are dutiable on importation at the rate of 10 per cent. *ad valorem*. Besides Government requirements, the free list includes, *inter alia*, scientific instruments, motor cars, machinery (all parts), and samples.

EGYPT.—Revised Tariff valuations for use in assessing duties on metals imported into Egypt have been issued with effect from September 1st to October 31st. Duty is leviable on these valuations at the rate of 8 per cent.

MEXICO.—The Board of Trade have received a copy of a Mexican Decree, dated July 31st, by which extensive alterations are introduced into the Mexican Customs Tariff, and a translation of the complete tariff, as amended, is published as a Supplement to the *Board of Trade Journal* of October 19th. The Decree abrogates the general surtax of 10 per cent. of the import duties, established in 1912. The general rules for the application of the tariff, the explanatory notes, and the tariff index are to be revised by the Ministry of Finance in conformity with the new Decree, which is to take effect as from November 1st. Goods imported in vessels which arrive at the Mexican port of importation after 12 o'clock midnight on October 31st will be subject to the new rates of duty.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

13,972. "Thermostats." FERRANTI, LTD., & R. WEAVING. October 2nd.

13,984. "Magnets for magnetic ignition apparatus for explosion or internal-combustion motors." C. A. HULT & O. W. HULT. October 2nd.

14,012. "Electric heating devices." R. K. HEARN. October 3rd.

14,027. "Magnetic compasses." F. BARKER & SON AND E. W. BARKER. October 3rd.

14,029. "Means for connecting electric lines for telephony, &c." L. C. BYGRAVE AND THE RELAY AUTOMATIC TELEPHONE CO. October 3rd.

14,031. "Wireless electric circuit-controlling apparatus." M. INOUE. October 3rd. (Japan, May 11th).

14,041. "Electrical apparatus." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). October 3rd.

14,057. "Apparatus and solutions and mixtures for conducting, conveying, and directing electrical currents by means of a jet." F. D. DOWLING. October 4th.

14,064. "Electrolytic manufacture of magnesium metal." E. A. ASHCROFT. October 4th.

14,065. "Electrolytic manufacture of sodium potassium alloys with or without other metals." E. A. ASHCROFT. October 4th.

14,068. "Repairing electric power transmission lines and other overground lines." J. A. HUSEBYE. October 4th.

14,081. "Electric arc lamps." H. B. GRYLLS & W. HEAPE. October 4th.

14,111. "Reflectors for electric bulb lamps." T. H. A. MCQUIN. October 4th.

14,113. "Electric conductors." J. D. SHAW. October 4th.

14,163. "Circuit-interrupting systems." BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. October 5th. (U.S.A., October 9th, 1915.)

14,169. "Electrically-propelled vehicles." F. W. A. RADFORD. October 5th.

14,215. "Electrolytic cells." J. W. WALKER. October 6th.

14,218. "High-tension magneto machines for ignition systems of internal-combustion engines." G. N. FELL (Bignami). October 6th.

14,246. "Ignition apparatus for internal-combustion engines." K. E. L. GUINNESS. October 6th.

14,247. "Ignition apparatus for internal-combustion engines." K. E. L. GUINNESS. October 6th.

14,262. "Non-sooting sparking plug for internal-combustion engines." C. S. HARRISSON. October 7th.

14,276. "Circuit interrupters." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. October 7th.

14,290. "Spears for current-testing apparatus for electrical appliances." W. J. DAVIS & C. E. HUNTER. October 7th.

14,291. "Recording attachment for electric current measuring and testing apparatus." W. J. DAVIS & C. E. HUNTER. October 7th.

14,293. "Means for supporting lengths of wire, particularly applicable to line insulators." BULLERS, LTD. October 7th.

PUBLISHED SPECIFICATIONS.

1915.

12,039. ELECTRIC SIGNALLING APPARATUS. J. W. Mackenzie (Otto G. H. E Kebrhahn, of U.S.A.). August 20th.

13,110. PORTABLE ELECTRIC LAMP FOR WRITING PURPOSES. P. Summerfield. September 14th.

13,129. ARRANGEMENT FOR PRODUCING SHORT UNIDIRECTED HIGH-TENSION ELECTRIC CURRENT IMPULSES. W. Otto. September 14th.

13,287. DYNAMO-ELECTRIC MACHINES. A. H. Neuland. September 17th.

13,480. DYNAMO-ELECTRIC MACHINES. F. A. Heys (Neuland Patents, Ltd.). September 22nd.

13,482. DYNAMO-ELECTRIC MACHINES. F. A. Heys (Neuland Patents, Ltd.). September 22nd.

13,483. DYNAMO-ELECTRIC MACHINES. F. A. Heys (Neuland Patents, Ltd.). September 22nd.

13,484. DYNAMO-ELECTRIC MACHINES. F. A. Heys (Neuland Patents, Ltd.). September 22nd.

13,561. DYNAMO-ELECTRIC MACHINES OF THE COMMUTATOR TYPE. G. Schroeder. September 23rd.

13,562. DYNAMO-ELECTRIC MACHINES OF THE COMMUTATOR TYPE. G. Schroeder. September 23rd.

16,207. TELEPHONE TRANSMITTERS. E. A. Grahame. November 17th.

16,469. PORTABLE ELECTRIC LAMPS. C. H. Hefford. November 22nd.

16,502. ELECTRIC SWITCH APPLIANCES. Mavor & Coulson, Ltd., and W. Lawrence. November 23rd.

1916.

The numbers in brackets are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

3,299. HIGH-TENSION MAGNETOS. A. H. Midgley and Vandervell & Co. March 4th, 1916. [101,439.]

4,190. PROCESS FOR THE ELECTROLYSIS OF ALKALI CHLORIDES. R. van Hasselt. March 21st, 1916. [101,440.]

4,901. ELECTRIC HEATING DEVICES. L. Heller. July 16th, 1914. (Divided application on 14,405/15.) [100,230.]

5,163. ELECTRICALLY INDICATING THE PRESENCE OF SALINE, ALKALINE, OR ACID IMPURITIES IN FEED-WATER USED FOR STEAM GENERATORS AND FOR OTHER PURPOSES. W. C. Crockatt & Bromell Patents Co. April 8th, 1916. [101,387.]

5,391. CONTINUOUS-CURRENT DYNAMO-ELECTRIC GENERATORS. Allmanna Svenska Elektriska Aktiebolaget. May 5th, 1915. [100,394.]

5,526. DYNAMO-ELECTRIC MACHINES. A. H. Neuland. September 17th, 1915. (Divided application on 13,287/15.) [101,447.]

7,291. REFILLABLE ELECTRIC FUSE PLUGS. J. G. Clemens. May 22nd, 1915. [100,538.]

9,332. MAGNETIC COMPASS. J. J. Steward. July 3rd, 1916. [101,466.]

9,937. DYNAMO-ELECTRIC POWER TRANSMISSION APPARATUS OF THE UNIPOLAR TYPE. M. Breslauer. July 10th, 1914. (Divided application on 8,334/15.) [100,894.]